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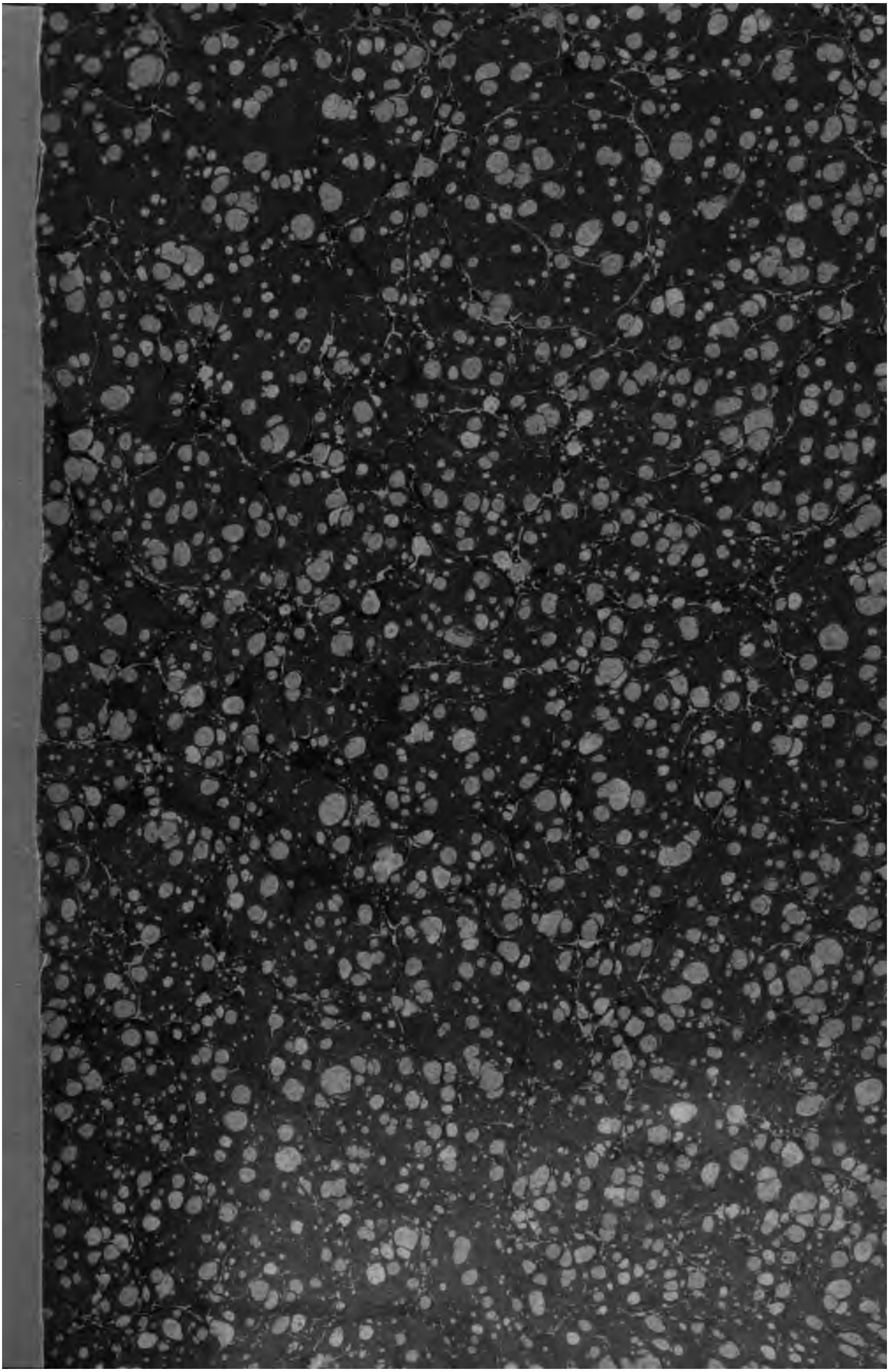

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J C Branner

TRANSACTIONS

OF THE

WAGNER FREE INSTITUTE OF SCIENCE

OF

PHILADELPHIA.

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WAGNER FREE INSTITUTE OF SCIENCE,
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CONTRIBUTIONS

TO THE

TERTIARY FAUNA OF FLORIDA,

WITH ESPECIAL REFERENCE TO THE

MIOCENE SILEX-BEDS OF TAMPA

AND THE

PLIOCENE BEDS OF THE CALOOSAHATCHIE RIVER.

BY

WILLIAM HEALEY DALL, A. M.,

Paleontologist to the U. S. Geological Survey.

PART I.

PULMONATE, OPISTHOBRANCHIATE AND ORTHODONT GASTROPODS.

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WAGNER FREE INSTITUTE OF SCIENCE

OF

PHILADELPHIA.

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PREFACE.

The Wagner Free Institute of Science, in its object to promote the cause of Science by encouraging original research and publishing the results, now issues the third volume of its Transactions, containing a description of fossil mollusca collected in Florida.

For the present, the Trustees of the Institute have considered it desirable to devote part of its available means to the exploration and investigation of the comparatively little known field of the geology and palæontology of Florida, which form the chief subjects of the former volumes of the Transactions as well as of the present one.

In the tertiary beds of Florida recently explored, there have been discovered many new and interesting fossil mollusca, forming the material of Mr. Dall's contribution, which will be found to be an important addition to the literature and knowledge of the tertiary fauna of our country. The paper embodies the results of the labors of several collectors; to whom the Institute desires to express its obligations; but especially to the U. S. Geological Survey, for the permission to use much of the material collected in Florida under the direction of the Survey.

JOSEPH LEIDY,
President of the Faculty and Director of the Museum.

TERTIARY MOLLUSKS OF FLORIDA.

PART I.

To the material described by Prof. Angelo Heilprin in the first volume of these Transactions much was soon added by the explorations of Mr. Joseph Willcox, the writer, Mr. Frank Burns, of the U. S. Geological Survey, and others. The number of species from the Plio-Miocene of Florida was, on the whole, about quadrupled, and, particular attention having been paid to the collection of the smaller species, it seemed that, of the Caloosahatchie Pliocene especially, a nearly complete enumeration of the mollusk fauna was made practicable. Hitherto the only attempt to monograph the fauna of any Tertiary horizon in the United States, with suitable illustrations, has been the fine quarto on the Pliocene of South Carolina by Messrs. Tuomey and Holmes. This work is unfortunately extremely rare and almost inaccessible to students, and, moreover, owing to the unconsolidated state of the beds in South Carolina, a considerable number of species belonging to the antecedent Miocene were included with the truly Pliocene species. Mr. Conrad and others have supposed, therefore, that the whole of the fauna described by Tuomey and Holmes belonged to the Miocene, and that there is not any development of Pliocene in that state. This opinion was as erroneous as that of the authors criticised, but in the opposite direction.

For these and other reasons connected with the later and more exact determination of our Tertiary faunas, it was thought desirable to make a thorough examination of molluscan remains of the Caloosahatchie beds, which might serve in some sense as a typical fauna with which those of other horizons might be critically compared and a better knowledge thus attained of the distribution, areal and geologic, of the animals of the Tertiary beds of Eastern North America.

Toward this end the authorities of the Wagner Free Institute of Science, the U. S. National Museum, under the direction of the Smithsonian Institution, and the U. S. Geological Survey have lent their aid.

The present paper is intended to include the greater part of the Gastropods. The second part will comprise the remainder of the Gastropods, the Pelecypods and Scaphopods in their biological sequence, together with a description of the beds from which the fossils have been derived and faunal lists for each horizon.

The condition of our Tertiary fauna has been hitherto very unsatisfactory from the redescription of species under several names from different localities, thus increasing the supposed faunal differences between different horizons and geographic areas. The nomenclature used has often been defective and far from up to date, while many fossils have been referred to wrong families and genera, because some of our paleontologists were not well acquainted with the progress in systematic classification of the recent fauna, which bears equally upon the extinct forms when they are perfectly recognized.

The present paper, it is hoped, will make a beginning in the direction of a better and more natural classification of our Tertiary mollusks and of a clearance of the ground of synonyms, erroneous identifications and other misconceptions. It is, of course, not to be expected that the work can be fully carried out except by the combined efforts of all our paleontologists and the expenditure of years of labor and scientific devotion. By using a biologic instead of a stratigraphic system of division for the animals studied, the relation of the different faunas at once takes on an absorbing interest. I believe that the practice common in museums of arranging the fauna of each horizon only in a series of drawers by itself, is responsible for much retardation in paleontologic science. The ideal museum should have two series, one stratigraphic and one biologic, and in the latter should be arranged together all the animals of one family from its earliest to its latest appearance. In the present state of science, if but one system can be adopted, I believe that the biological sequence is by far the most important, notwithstanding some obvious inconveniences which attend it.

To the institutions above mentioned and to the officers of the Academy of Natural Sciences, Philadelphia, the members of the U. S. Geological Survey, and especially to Mr. Joseph Willcox, Mr. James Shepard, of New Britain, Connecticut; Mr. F. W. Crosby, of Washington, and various friends and correspondents in Florida, my thanks are due for co-operation and assistance.

The types of the fossils described are deposited in the Museum of the Wagner Free Institute of Science and the U. S. National Museum. The Museum of the Philadelphia Academy of Natural Sciences and the U. S. National Museum contain most of the original types of Conrad and other early paleontologists, and with them, when any question arose, the specimens here described have been carefully compared.

The drawings which have been photographically engraved for the illustrations of this paper were drawn with the pen by Dr. J. C. McConnell, of Washington, and Mr. J. H. Ridgway, of the U. S. Geological Survey. All those representing small species were outlined by camera. I think that these illustrations speak with sufficient clearness for themselves.

LAND AND FRESH-WATER FAUNA OF THE SILEX-BEDS.

This peculiar association of species whose abundance marks a special phase in the history of the silex-beds, namely, the culmination of the upward movement, I have decided to treat separately. This fauna was not of sudden appearance. Doubtless as soon as small hummocks became sufficiently elevated to be above the incursions of the tide they were invaded by the operculate *Helicina* and the beach-frequenting *Strophia*. The other land snails were probably later, but the fresh-water species would necessarily be delayed until the supermarine area was large enough to afford fresh-water ponds or streams not invaded by salt water. These last were naturally the latest and are the rarest, while the *Helicina* is found more or less mixed with the marine shells lower down, where it had been blown by the winds or washed by extraordinary storm-tides.

FAMILY VIVIPARIDÆ.

Genus **LIOPLAX** Troschel.

Lioplax floridana n. s.

Plate 1, figure 3.

Shell thin, smooth, or slightly marked by incremental lines; the upper or posterior half of the whorls somewhat flattened; the periphery obtusely keeled; base well rounded; umbilicus none, whorls probably four or five, the type specimen decollated; suture distinct but not channelled; aperture rounded in front, narrow but not acute behind; outer lip, simple, thin. Lon. of decollate specimen 7.5; lat. of do. 6.0 mm.

A single specimen in poor condition, but characteristic, was collected by the writer at Ballast Point. It is sufficiently distinct from the *L. subcarinata* Say to need little comment; the flattish and peripherally angular whorls of the fossil enable one to discriminate between them at once.

FAMILY HELICINIDÆ.

Genus **HELICINA** Lamarck.

Helicina ballista n. s.

Plate 1, figures 2, 2 a.

Shell depressed-conic, five-whorled, solid, spire less than half the height of the shell; whorls slightly flattened above; suture distinct, not deep; sculpture of incremental lines and occasional not prominent wrinkles, crossed by faint impressed lines, with subequal interspaces, to the number of six or seven on the last whorl above the periphery; base full, evenly rounded, with a thin, smooth central callus; aperture oblique, semilunar; lip reflected, and in old specimens very thick, narrowest and thinnest near the pillar, which is very short and almost unrecognizable as distinct from the lip; alt. of shell 7.0; max. diam. 10.0; min. diam. 8.0 mm.

Helicina ballista var. **tampæ** Dall.

Shell similar, but smaller, though with the same number of whorls, and an appearance of being slightly flatter on the spire, and generally smooth; alt. 5.0; max. diam. 8.0; min. diam. 6.5 mm.

Ballast Point silex-beds, upper part, and also in the overlying Orbitolite rock, and in the latter at Six-Mile Run, near Orient Station, east from Tampa City. This species has been compared to *H. substriata* Gray, now living at Barbados. There are many points of resemblance, but the typical form of the fossil is larger and much heavier, with a stronger lip, which narrows and becomes thinner near the pillar just where the living species has its thickest and strongest part. In this character the two are the exact opposite of each other. The variety agrees with the typical form of *H. ballista* as regards this character. Though the shell is common and has a wider geologic range than the others of this assemblage, no trace of the operculum has been found so far. The specimen figured does not show the spiral lines, which are inconstant in both the fossil and the recent species referred to.

FAMILY LIMNÆIDÆ.

Genus **PLANORBIS** Guettard.

Planorbis Willcoxii n. s.

Plate 1, figures 6 c, 6 d.

Shell small, with five or more slowly enlarging rounded whorls; surface sculptured only with inconspicuous incremental lines; coil dextral (?), upper and under surfaces very similar; upper side more deeply indented with about three turns visible, the suture not very deep and the surface slightly flattened; under side with a deeper suture, and the whorls more boldly rounded; aperture lunate, outer lip defective in the specimen, but probably simple and sharp. Diameter of type specimen 6.5; altitude 2.3 mm.

A single specimen was collected at Ballast Point by the writer.

This species is most like the recent West Indian *P. circumlineatus* Shuttleworth, but has more symmetrically rounded whorls, a proportionally smaller altitude, and shows no traces of the spiral lines. The last whorl is much larger in proportion to the rest of the shell in the living form. The fossil is much like several of the species of *Segmentina*, *S. havanensis* Pfr. and allied recent forms, but it has no internal teeth.

FAMILY HELICIDÆ.

SUBFAMILY BULIMULINÆ.

Genus **BULIMULUS** Leach.

Section *Anctus* Albers.

The *Bulimuli* of the Florida Miocene are obviously nearly related to one another; and, whatever group they may be referred to, all will be included in it. They are characterized by small size, a form somewhat recalling that of

Partula ; which, among recent species, is exaggerated to oddity in the recent *B. angiostomus* Wagner, of South America, the type of Albers' section *Anctus*. All have the aperture somewhat laterally compressed or pinched, and the lip broadly reflected.

The outer lip is usually a little thicker in the middle than near the body, there is a little callus on the body uniting the lips, the pillar is simple and with no indications of a fold or swelling. The umbilicus is represented by a chink, not a perforation, behind the inner lip and the aperture is less than half the whole length of the shell. At the commissure between the outer lip and the body a small mass of callus is deposited by the perfectly adult animal which is marked by a straight or somewhat flexuous sharp groove, which occupies the middle of the callus. All the fossils and several of the South American forms among the recent species possess this grooved callus and have the spire rather sharply tapered, though the vertex is not very acute.

The largest of the Floridian species was referred to *Partula* by Prof. Heilprin, and it has much the form of some *Partulæ*, but it seems to me the obvious relations of the group with those of the Antilles and South America render it highly improbable that its nearest relations are to be sought so much farther away. Moreover, the genus *Partula* is likely to be a very modern development not to be expected in the Miocene, and especially in the American Miocene, any more than *Achatinella*. I suspect that *Pupa* (or *Bulimulus*) *fallax* Say may be a degenerate descendant of our Miocene group, as its form is much the same and the only obvious difference in the shell is one of size. A small shell somewhat resembling our land shells but without the reflected lip and generally more like the group *Thaumastus*, to which he referred it, was described by Meek and Hayden from the Fort Union Lignite group of Dakota, under the name of *Thaumastus limneiformis*. The type, however, looks more like an *Amaura* than a land shell. I do not find anything figured from the European strata of analogous age which can be closely affiliated to our shells.

Bulimulus (? Anotus) floridanus Conrad (sp.).

Plate 1, figure 11.

Bulimus floridanus Conrad, Silliman's Journal, second series, vol. ii. p. 399, figure 1, Nov. 1846. Am Journ. Conch., i. p. 144, pl. xi. fig. 11, 1865 (bad figure).
Not *Bulimulus floridanus* Pfr., 1856 (recent).
Eulima floridana Orbigny, fide Conrad, *op. cit.*, 1865 (Ubi ?).

Shell fusiform, anteriorly and posteriorly tapering, rather slender; tip small, bluntly pointed, whorls moderately rounded, six in all; the maximum length of the aperture equals less than half the total length; aperture with a reflected margin, broader anteriorly and on the pillar; the original type which we have figured is not entirely adult and the reflection is wider in a perfectly mature individual. The inner and outer lip are connected by a perceptible callus which is grooved slightly in the angle between the outer lip and the body whorl. The aperture is slightly laterally compressed; there is a narrow chink behind the reflected pillar-lip. The outer surface of the whorls is pretty regularly grooved, in harmony with the incremental lines, by close-set narrow shallow grooves and wrinkles between them; on the upper whorls in the type specimen there are traces of distinct fine sharp spiral grooves; the suture is distinct, but not channelled; the succeeding whorl is uniformly appressed against it and the subsutural line mentioned by Conrad has no expression in the sculpture, but is due to the greater transparency of the silex, as compared with the sandy matrix filling the whorls. The upper whorls are more or less eroded, but the characters are sufficiently distinct. Length of the truncated type 10.0; of the last whorl 7.0; max. width of the shell 4.0 mm. Our largest specimen measures 14 by 6 mm. and an average one 13 by 5. mm.; the aperture 6 by 3.7 mm.

Habitat, silex-beds of Ballast Point, Tampa, Florida; collected by Conrad, Dall and F. Burns.

I have been favored, through the kindness of Prof. Heilprin, with the opportunity of comparing and figuring Conrad's original and until lately unique type which forms part of the collection of the Academy of Natural Sciences.

It differs from the following species in being more elongated and less abruptly tapered at the ends; it seems also to have had a reflected lip more like that of *americanus* than of *Heilprinianus*, and without the pronounced inward projection which distinguishes the latter, in the middle of the outer lip. Before comparing them I had supposed that *floridanus* was merely an immature *Heilprinianus*, but when they were brought side by side the difference was patent. I feel quite confident that, so far as the shell affords a criterion, the three species I have mentioned belong to a single section of the genus *Bulimulus*. There is nothing remarkable in finding three species of one group in the same local fauna, while one or two closely related species still survive in the vicinity; and, as we go south, among the Antilles and especially in the northern part of the continent of South America, species of the same section apparently become more numerous and their peculiar features more pronounced.

The revolving lines are not shown in the figure, as they are only visible on a portion of the back. Over the greater portion of the surface of the siliceous pseudomorph, only the much stronger transverse ridges are perceptible, and in some places even those have been obscured, in the process of mineralization or perhaps by erosion of the original shell before it was replaced by a siliceous cast.

Bulimulus (? Anctus) Heilprinianus n. s.

Plate 1, figures 6 b, 10.

Shell small, fusiform, six-whorled; the spire rather pointed conical; sculpture of fine transverse wrinkles with faint spiral striæ in places; suture distinct but not deep, the whorls appressed against it; base rounded, with a very narrow chink in the umbilical region, but no perforation; aperture less than half the length of the shell, the lip reflected, thick and solid; pillar simple, rounded into the base; body washed with callus connecting the lips; at the commissure of the body and outer lip a small grooved callus is distinct in the adult; posterior inner edge of the outer lip with an excavation in front of which is a projecting thicker part which in the oldest specimens is almost toothlike; the reflected face of the lips lies in one plane; the aperture slightly compressed laterally. Lon. of shell 11.0; of aperture 4.5; lat. of shell 4.0 mm.

Silex-beds of Ballast Point, Tampa Bay; collected by Dall and Burns.

This species has a differently formed and relatively shorter mouth and much heavier lip than the others. Like them it varies somewhat in size and proportions. Figure 6b is intended to show the callus and the groove at the junction of the body and outer lip. Sometimes, however, the callus is of a leaf-shape, with the groove in the center, like the midrib of a laurel leaf. In *B. americanus* this is especially prominent. The groove in the figure is a little too straight, as it has usually a slight flexure to correspond with the convex surface upon which it lies.

Bulimulus (? Anctus) americanus Dall.

Plate 1, figures 9, 9 a.

Partula americana Heilprin, Trans. Wagner Inst. I. p. 115, pl. xvi. fig. 60, 1887.

Silex-beds of Ballast Point and vicinity, abundant; a single, possibly adventitious specimen in the Orbitolite bed at the same locality in the uppermost stratum. Collected by Messrs. Shepard, Willcox, Newman, Heilprin, Dall and Burns.

	Whorls.	Alt. of Shell.	Max Diam.	Apert. Long.
Forma typica,	6½	17.0	9.0	8.5
Var. *partulinus* Dall,	6	13.5	7.5	7.0
Var. *laxus* Dall,	6.	15.5	7.2	7.5

This species, though showing some slight variations, is on the whole remarkably constant in form and size, averaging in length of shell 17, of aperture 8, and maximum diameter 8 mm. The reflected lip, though wide, is not heavy, but the callus uniting the lips over the body and the groove at the commissure are relatively more conspicuous than in the smaller species. No trace of spiral scratching or sculpture has been discovered after examining many specimens. The varieties were found with the typical form, but seem tolerably constant.

Bulimulus (? Anctus) Stearnsii Dall.

Plate 1, figure 12.

Shell small, elongated, with five or more whorls; surface nearly smooth or slightly transversely striated in harmony with the incremental lines and with faint indications of microscopic spiral striæ; type-specimen decollate; whorls slightly rounded, appressed at the distinct but not channelled suture; last whorl rather long, with a very narrow chink behind the reflected inner lip;

aperture short, laterally compressed; lip reflected, thin, body callus distinct, grooved at the outer commissure, pillar simple; lon. of type-specimen (decollate) 13.0; of last whorl 9.0; of aperture 5.0; max. lat. of shell 4.5 mm.

Ballast Point silex-beds; collected by W. H. Dall, a single specimen.

This species is at once separable from the preceding by the elongated and slender form which it exhibits. It is smoother than the others, if the specimen found be a fair example of the sculpture.

It is named in honor of Dr. R. E. C. Stearns, of California, who in 1869 visited Ballast Point and by his discovery of *Ecphora quadricostata* on Long Key determined the presence of beds of the Miocene age.

SUBFAMILY HELICINÆ.

Genus **HELIX** Linné.

Subgenus **Hygromia** Risso.

Section *Jeanneretia* Pfeiffer.

The type of this section is *H. multistriata* Desh., and it includes, among other recent forms, *H. Parraiana* Orb., and four or five others from the Cuban region. Among fossil species can be noted those here described, and from France, *H. Prestwichii* Deshayes, *H. rara* Boissy, and *H. Noueli* Deshayes. *H. aquensis* De Serres, from the Middle Tertiary of Aix, is another related form. *H. Prestwichii* and *rara* are from the Eocene Lignites of Epernay; *H. Noueli* from the Calcaire de Beauce of France and equivalent beds in Northern Italy.

The most obvious feature of all these shells is the constriction which takes place just behind the reflected lip, and the thickened ridge which reinforces the lower lip internally near the base of the pillar, yet which is too obscure and too irregular to be called a tooth. These shells are mostly rather depressed, with a moderately sculptured surface, and a closed or narrowly perforated umbilicus. Some are turbinate in form, like the type of the section. All have a reflected lip and an oblique aperture. Their close relation to the Cuban species already mentioned is obvious, and their parallelism of character with those of the earlier beds of the Paris basin is in harmony with the want of synchrony between otherwise analogous faunæ of Europe and America which has been pointed out on several occasions.

Helix latebrosa n. s.

Plate 1, figures 8, 8 a.

Shell rotund, full and rounded above, five-whorled; surface marked by incremental lines and faint wrinkles, and by traces of faint microscopic spiral striation; suture very distinct, its anterior margin not appressed; whorls full, the last slightly flattened behind the periphery of the last half of its extent, base rounded with a small, deep, tube-like umbilicus; constriction behind the reflected lip, deep, wide, and more strongly wrinkled than the rest of the outer surface; pillar oblique, very short, the lip reflected behind it to the verge of the umbilicus; body with a callus connecting the inner and outer lips; outer lip defective in the specimen, but evidently arched over and deflected downward on the body, slightly contracting the aperture, reflected portion wide, thin, smooth; margin of the lower lip in a partly vertical plane within, supporting a large, thick, somewhat granulose callus; max. lat. of shell 16.0; min. lat. 13.5; alt. 12.0 mm.

A single specimen was collected by the writer at Ballast Point. A fragment, apparently of this species or a closely allied form, was sent from the Ocala nummulitic bed by Mr. Willcox.

Helix instrumosa n. s.

Plate 1, figures 7, 8 b.

Shell depressed, slightly and very obtusely carinate toward the periphery, especially in the young, five-whorled; surface with a microscopic shagreened sculpture, caused by the breaking up of fine incremental wrinkles into segments, which are sometimes so small as to resemble minute pustules; this sculpture varies on different parts of the same specimen, and in different specimens to some extent, but preserves its general character in all, though it is generally most developed on the spire; apart from this and the usual incremental irregularities there is no sculpture on the shell; whorls depressed, suture distinct, not deep; base evenly rounded, with a central perforation, a small portion of which is overshadowed by the reflection of the pillar-lip; constriction narrow, deep; aperture a little declining, very oblique; lip rather thick and widely reflected, narrower below and then expanding a little at the pillar; callus deeper in the throat than in *H. latebrosa*, and less prominent, though it may not be fully developed in the single specimen of this species in which it has been preserved at all; alt. 8.0; max. diam. of shell 13.5; min. diam. 11.0 mm.

This interesting species was collected at Ballast Point by the writer, four or five more or less broken specimens, from the total of which is obtained the above description. The specimen figured has the upper edge of the outer lip slightly defective, and in figure 7 the spire above the penultimate whorl has been restored from one of the other specimens in which that part of the shell was perfectly preserved.

Helix crusta n. s.

Plate 1, figures 4, 4 a, 4 b, 6 e, 6 f.

Shell moderately depressed, rounded without any carina or angulation at the periphery, five-whorled; surface marked with incremental lines and fine wrinkles in harmony with them, which are broken up into shagreening much as in the last described species; other sculpture none; whorls above somewhat rounded; suture distinct, margin not appressed; base full, slightly compressed toward the umbilicus, which is deep, subtubular and small, partly overshadowed by the reflected pillar-lip; constriction behind the aperture pronounced, narrow, close to the reflection; aperture very oblique, subcircular, the reflected lips narrow, rather thin, subequal all round, united by a thin callus over the body whorl; callus within the lower lip thin, small, little elevated, but distinct in fully adult specimens, at the base of the pillar. Alt. of shell 8.0; max. diam. 15.0; min. diam. 12.0 mm.

Helix crusta var. **cunctator** Dall.

Shell smaller, with four and a half whorls, the umbilicus relatively smaller, the base more bevelled toward the umbilicus. Alt. 6.0; max. diam. 11.0; min. diam. 9.0 mm.

Ballast Point silex-beds; also the same formation on the shores of Old Tampa Bay, an arm of Tampa Bay proper, westward from Hillsborough Bay; collected by Newman, Dall, Shepard and Burns.

This is much the commonest species of the Ballast Point locality and is frequently very perfectly reproduced by the siliceous pseudomorph. Of the variety three rather encrusted specimens were found. Better material may lead to the belief that it is a distinct species, in which case the varietal name now used will be applicable as a specific name.

Helix diespiter n. s.

Plate 1, figures 1, 1a.

Shell closely resembling *H. crusta* in form, but larger, with a more covered umbilicus, more horizontally flattened base, and especially a larger and more oval aperture, with a more pronounced expansion where the inner lip joins the body; the shagreening of the surface is like that of *H. crusta*, but the incremental wrinkles seem relatively stronger. Alt. 11.0; max. diam. 18.0; min. diam. 15.0 mm.

Ballast Point silex-beds, abundant, but almost always broken and defective; collected by Dall and Burns.

This species is closely related to *H. crusta*, but seems uniformly to differ as above mentioned. The figure is an ideal one, derived from the obvious characters of several partly defective specimens.

Helix direpta n. s.

Plate 1, figures 7a, 7b.

Shell elevated, stout, subglobose, with five to six and a quarter whorls; surface nearly smooth, marked with lines of growth and fine, microscopic, close-set spiral striation; apex rather blunt; whorls moderately full, suture distinct, not deep, the margin not appressed; base moderately rounded, the umbilical region indented but not perforate; close to the aperture the last whorl descends a short distance; the constriction behind the lip is not deep, though obvious; aperture wider toward the outer side, the pillar and the end of the outer lip where it joins the body whorl are rather close together and the interval is covered with a rather thick, smooth callus over the body whorl; lip stout, thick, reflected, the reflection somewhat expanded over the umbilical region of the base. None of the specimens show the inner face of the lower lip. Alt. 12.5; max. diam. 15.0; min. diam. 12.0 mm.

Ballast Point silex-beds; Dall and Burns.

This species is rare; only four specimens have been found. The one figured had lost the shelly matter of the base and aperture and was unique; the others have been found since the figure was made and are all defective, but enable the description to be made tolerably complete.

Helix haruspica n. s.

Plate 1, figures 7 c, 7 d.

Shell large, thin, little elevated, with five and a half whorls; surface with more or less broken incremental wrinkles, crossed by fairly distinct fine grooves rather sparsely distributed; periphery furnished with a distinct carina, above which the whorl is somewhat compressed, and on which the suture runs; at the termination of the coil the end of the last whorl falls below the carina for a short distance; suture distinct; upper whorls less rounded than the last one; base moderately rounded, perforate when young, the umbilicus covered by an extension of the inner lip in the adult; aperture large, imperfect in all the specimens; lips moderately reflected, thin, sharp; constriction behind the reflection hardly noticeable near the suture (elsewhere ?), lower lip wanting in the specimens; inner and outer lip connected with a thin callus over the body whorl. Alt. of shell from base to vertex, the aperture not taken into account, 12.0 mm., but with the lower lip perfect it would have been 15.0 or more, probably; max. diam. 24.0; min. diam. 19.5 mm.

Ballast Point, Hillsboro Bay, silex-beds; collected by Mr. J. Shepard and the writer.

This is the largest *Helix* of the locality so far discovered, and, though imperfect, is recognizable. When living it must have much resembled some of the West Indian carinated forms, like *acutissima* Lam. These last have the shagreened surface, but it seems as if the callus within the inner lip seen in the fossils has differentiated into separate tooth-like projections in some of the recent forms, while persisting hardly changed in others. It may be, however, that the lower lip of this species will show internal denticles when it is found. As what remains of *H. haruspica* harmonizes well with others above described of the section *Jeanneretia*, I have not thought it worth while to refer it elsewhere, especially as I by no means claim expertness in the discrimination of the myriad sections and subgenera which have been proposed in this family.

Subgenus **Polygyra** Say.

Section *Dædalochila* Beck.

Helix adamnis n. s.

Plate 1, figures 5, 5 a.

Shell small, depressed, five-whorled ; surface nearly smooth except for incremental lines and occasional faint wrinkles · suture distinct as in recent species of this group; periphery angulated rather obtusely, on which angle the· suture runs and at the aperture does not perceptibly decline below it, although the aperture is oblique; the sides fall inward from the carina; the base is rounded with a small funicular umbilicus; at the termination of the last whorl it is slightly swollen, then slightly constricted, then expands again to the subequal thick margin of the aperture, which is marginated rather than reflected; on the lower lip are two subequal denticles which are not extended into the throat; about the middle of the outer lip the end of a ridge projects from the margin and the ridge itself is continued obliquely downward and backward on the inside of the outer lip until it reaches a point nearly behind the outer basal denticle. The outer and inner lips are joined over the body by a >-shaped lamina, the upper arm of which is shorter than the lower; the apex extends backward behind the plane of the lower lip, while the space between the arms of the > is covered with a pretty thick layer of callus. Alt. 4.5 ; max. diam. 9.1 ; min. diam. 7.5 mm.

A single specimen was collected at Ballast Point by the writer.

This is the earliest American *Polygyra* as far as known. A species is mentioned from Idaho (Dakota) in Conrad's "Eocene Checklist," published by the Smithsonian Institution in 1866, but I can find no record of its publication anywhere, and suspect that further study resulted in its suppression. The specimen is not in the National collection and the name is therefore to be suppressed.

The present species is a full-fledged *Polygyra*, of the section *Dædalochila* Beck, with all the characters which are exhibited in such species as *P. ventrosula* and *P. Hindsii* of Pfeiffer. It is probable, therefore, that the group was developed at an earlier date and that we may yet find incipient or even characteristic species of *Polygyra* in the Eocene. The nearest related recent species, above cited, inhabit Texas, Mexico and the adjacent region.

SUBFAMILY PUPINÆ.

Genus **STROPHIA** Albers.

Section *Eostrophia* Dall.

Shell destitute of internal lamellæ or denticles. Maynard has shown that the species of *Strophia* now living may be separated into three groups by the form and arrangement of the gular laminæ or callosities. But according to him there are none known among recent *Strophias*, which are entirely destitute of such laminæ, like the Miocene forms now under consideration.

Strophia (Eostrophia) anodonta n. s.

Plate 1, figures 8 c, 8 d.

Shell subcylindrical, obtuse, nine or ten-whorled, apparently smooth, but under a magnifier showing fine parallel grooves and wrinkles extending obliquely from suture to suture, in harmony with the incremental lines; suture distinct, not deep; base full and rounded with a chink in the imperforate umbilical region; aperture slightly expanded, rounded, the lip strongly reflected, so that it is rounded in front and sharp-edged behind; a thin callus connects the inner and outer lips over the body, but there are neither parietal nor columellar laminæ. Alt. 24.0; max. diam., excluding the aperture; 11.0; diam. of aperture from outside to outside of lips 9.0 mm.

Ballast Point, Newman, Shepard, Dall and Burns; Old Tampa Bay, shore, Burns.

Strophia (anodonta var. ?) **floridana** Dall.

Plate 1, figure 6.

Shell resembling the preceding and with the same number of whorls, but shorter and stouter, and with a somewhat larger aperture proportionally. Alt. 22.0; max. diam. of spire 11.1; of aperture 9.0 mm.

Ballast Point; Dall.

This interesting form has been compared to *Strophia incana* Binney, which it resembles in outline but not in sculpture, while *S. incana* has both parietal and columellar laminæ.

An examination of a couple of dozen more or less perfect specimens fails to show any indications of laminæ and there can be little doubt that the species is normally edentulous. The variety is sufficiently different in appearance to be worth naming, but such differences are not of specific value among the recent *Strophias*.

FAMILY CYLINDRELLIDÆ.

Genus **CYLINDRELLA** Pfeiffer.

Section *Gongylostoma* Albers.

Cylindrella floridana n. s.

Plate 1, figure 6a.

Shell resembling *C. variegata* Pfr., but larger and more coarsely sculptured; whorls eight after decollation, shape fusiform, whorls gently increasing in diameter from the decollation to the sixth whorl, which is the largest, after which the diameter becomes less; suture distinct; whorls sculptured with fine transverse ridges, separated by equal or wider interspaces, which cross the whorl from suture to suture, with rare irregularities; base subcarinate in continuation of the line of the suture and on the last whorl slightly constricted above this carina; umbilicus none; aperture subcircular, oblique, with reflected lip, internally simple, smooth. Alt. of shell 11.5; max. diam. of spire 4.0 mm.

Ballast Point, Dall ; two imperfect specimens.

This is larger, stronger and coarser than *C. variegata* Pfr. of Cuba, and *C. jejuna* Gould of Florida, once considered a variety of the Cuban species, may be a degenerate descendant of our Miocene shell.

TERTIARY MOLLUSKS OF FLORIDA.

GASTROPODA.

Order OPISTHOBRANCHIATA.

FAMILY ACTÆONIDÆ.

Genus ACTÆON Montfort.

Actæon punctostriatus C. B. Adams.

Tornatella punctostriata C. B. Adams, Bost. Journ. Nat. Hist., III. p. 323, pl. iii. fig. 9, 1840.
Tornatella punctata Orbigny, 1842, not of Férussac, 1823; Lea, 1833 ; or Piette, 1855.
Actæon cubensis Gabb, Geol. St. Domingo, p. 245, 1873.

Caloosahatchie beds, several specimens; recent, in 2–63 fathoms, from Cape Cod to the Antilles. It is also found in the Miocene of New Jersey, at Shiloh, and possibly (as *A. textilis* Guppy) in the Miocene of Jamaica and Haiti.

Actæon punctatus Lea.

Actæon punctatus Lea, Contr. Geol., p. 111, pl. iv. fig. 96, 1833.
Monoptygma elegans Lea, *op. cit.*, p. 203, pl. vi. fig. 217.
Actæon pomilius Conrad, Foss. Shells Tert. Form., p. 45 (not figured), 1833; *fide* Conrad.
Not *Tornatella punctata* Férussac, 1823 = *T. sulcata* Gmelin.
Not *T. punctata* Piette, 1855.
Not *Tornatella elegans* Sowerby, 1841, nor of Méleville, 1843.

Caloosahatchie beds, one specimen ; Claiborne sands, Lea and Conrad.

A single specimen with decollated spire found in the Florida marl does not seem separable from the Alabama species. I have not seen it in the recent state.

Actæon magnoplicatus H. C. Lea (Am. Journ. Sci., vol. 40, p. 94, pl. i. fig. 5, 1841), from the type, is a broken *Odostomia*. It belongs to the Claiborne sands horizon.

Genus RINGICULA Deshayes.

Ringicula floridana Dall.

Plate 3, figure 8.

R. floridana Dall, Rep. on Blake Gastr. Bull. Mus. Comp. Zool., xviii. p. 44, June, 1889.

Caloosahatchie beds ; rather rare.

Ringicula (**floridana** var. ?) **Guppyi** Dall.

Plate 3, figure 7.

R. (*floridana* var. ?) *Guppyi* Dall, *op. cit.*, p. 44, June, 1889.

Pliocene of the Caloosahatchie, Alligator Creek and Shell Creek beds.

This species measures 1.6 mm. long by 1.0 broad, with slight variation in height and strength of the spiral sulci which are very faint sometimes. It is always differently proportioned, thinner and more delicate than *R. tridentata*

Guppy of the Jamaica Miocene, which is not sulcate. It is figured in the proper proportional relation to the figure of *R. floridana*, which is 2.5 x 1.5 mm. with five whorls. It may prove a dwarf race of *R. floridana*, but I have not found a connecting series so far. The present form has one whorl less than *R. floridana*, notwithstanding which the nucleus is larger in *R. Guppyi*. The latter is more abundant and so far has not been found recent. The species described by Conrad and Lea are all larger than the Pliocene fossils.

FAMILY TORNATINIDÆ.

Genus **TORNATINA** A. Adams.

Tornatina Wetherilli Lea.

Actæon Wetherilli Lea, Cont. Geol., p. 213, pl. vi. fig. 224, 1833.
Tornatina Wetherilli Conrad, Am. Journ. Conch., i. p. 35, 1864.
T. coixlacryma Guppy, Geol. Mag., IV. p. 500, fig. 3, 1867.

Orbitolite bed, over the silex-bed, near Tampa, Florida; at Lapenotiere's Sulphur Springs; from wells dug in the town and near it; rare; also at Deal, N. J. (Lea).

This form is intimately related to *Tornatina recta* Orb., from which it differs only in its larger size, stouter form and slightly more elevated spire. It is somewhat intermediate between *T. bullata* Kiener and *T. recta*. The two latter species are recent in the Antillean region and *T. recta* has been found living on the Floridian coast. I have examined Lea's type-specimen, which is said to have come from a bed of Older Pliocene age.

I can hardly doubt that this shell is identical with *T. recta* Gabb (as of Orbigny), which is the same as Guppy's species. It is common to the Miocene of St. Domingo, Trinidad and Jamaica. *T. canaliculata* Say, non Orbigny, is distinguished by its more depressed spire, more pronounced anti-sutural channel and more rectangular profile.

Tornatina canaliculata Say.

T. canaliculata Say, Dall, Bull. U. S. Nat. Mus., No. 37, p. 84, pl. 52 fig. 57.

Miocene of Bowden, Jamaica, W. I.; Pliocene of the Caloosahatchie River, Myakka River, Shell Creek and Alligator Creek, Florida; Post-Pliocene of Simmons' Bluff, South Carolina; North Creek and other localities in Florida; recent on the Atlantic Coast from Cape Cod to the Florida Keys and Gulf of Mexico.

This species is very widespread and variable both in the recent and the fossil state.

Subgenus **Cylichnella** Gabb.

Cylichnella ovum-lacerti Guppy.

Cylichna ovum-lacerti Guppy, Geol. Mag. 1, p. 437, pl. xviii. fig. 22, September, 1874.
Cylichnella ovum-lacerti Dall, Blake Rep. Gastr., p. 45, 1889.

Lower Eocene of Trinidad at Manzanilla, Guppy; Pliocene of the Caloosahatchie beds, Florida, Dall; ? Miocene of Haiti (as *C. bidentata*) Gabb and Guppy, *l. c.*

There appeared to be no ground for distinction between Guppy's shell and the Floridian specimen. The latter approaches the recent *C. bidentata* Orbigny less closely.

Genus **UTRICULUS** Brown.

Subgenus **Utriculus** s. s.

Through a typographical error in my list in the Bull. U. S. Nat. Mus., No. 37, p. 86, *U. Gouldii* and *U. pertenuis* were included in the subgenus *Retusa*, to which they do not belong.

Utriculus vaginatus n. s.

Shell small, elongate ovate in profile, with a subtruncate spire above the last whorl; surface smooth or marked with incremental lines; whorls three or four; spire depressed, barely visible above the last whorl; suture narrow, deeply excavated, the rim in front of it sharp; last whorl descending toward the aperture; shell slightly wider in front than behind; aperture very narrow behind, more than three times as wide in front; outer lip simple sharp, rounding imperceptibly into the simple unplicate pillar, behind which there is no umbilicus; lon. 4.0; lat. 2.0 mm.

This is a very well marked species, recalling in miniature the *U. Mayoi* of the New England coast. The latter, however, though the suture is deep, has it relatively shallower than in the fossil species, and the margin in front of the suture is rounded over. In *U. vaginatus* it is as sharp as in an *Olivella.* Two specimens were obtained from the silex-beds at Ballast Point, Tampa Bay.

Subgenus **Retusa** Brown.

Retusa sulcata Orbigny.

Bulla sulcata Orb. Moll. Cuba, I. p. 129, pl. iv. *bis*, figs. 1-12, 1841.
Retusa sulcata Dall, Bull. U. S. Nat. Mus. No. 37, p. 86, 1889.

Caloosahatchie beds, one specimen. Recent on the coast from Cape Hatteras southward to Santa Lucia, West Indies.

I may add here that *Volvula cylindrica* Gabb (1873), from the Santo Domingo Miocene, and *V. oxytata* Bush, from the recent fauna near Cape Hatteras, are one and the same species.

FAMILY SCAPHANDRIDÆ.

Genus **SCAPHANDER** Montfort.

Section *Bucconia* Dall.

Shell differing from the typical *Scaphander* (*S. lignarius*) in having no ridge or carina around a sunken vertex, in having (as it were) a posterior pillar extended backward and supporting an expansion of the outer lip, and in its globose instead of pyriform outline.

In the soft parts the admedian teeth of *Bucconia* are shorter, the rhachidian tooth proportionally larger, the lateral platės of the gizzard are rounded quadrate instead of rounded triangular, as in the typical species. Type *Scaphander nobilis* Verrill, Trans. Conn. Acad. Sci., vi. p. 209, pl. xxxii. figs. 18–18 d, 1884. The other features of the soft parts are presumably like those of typical *Scaphander*, to which Verrill referred it. The distinctions between these sections of the genus are obvious and are not fully bridged by any of the species, though *S. punctostriatus* points the way. The two sections are by no means modern, both being represented in the Eocene. *Bucconia* is a thin-shelled *Sabatia* without a body-callus.

Scaphander (Bucconia) grandis Aldrich.

Plate 10, figure 9.

Haminea grandis Aldrich, Geol. Surv. Alabama Bull. No. 1, p. 35, pl. 3, fig. 1, 1886.

Jackson group of the Eocene at Bunker Hill, Louisiana, Aldrich. Ocala beds, Central Florida, Willcox.

I have refigured this magnificent species from a fine specimen obtained at Ocala, measuring 66 x 40 mm.

Section *Scaphander* s. s.

Scaphander primus Aldrich.

Scaphander primus Aldrich, Journ. Cin. Soc. Nat. Hist. 1885, p. 148, pl. 2, figs. 7 a, 7 b, July, 1885.

Vicksburg beds at Red Bluff, Miss., Aldrich. Orbitolite bed at Tampa City and 6 miles northeast from Tampa, near Lapenotiere's Sulphur Spring; Dall. These are casts, but agree very well with Aldrich's figure. The largest measures 29 x 16 mm. The shell is rather thick for the genus, and about one-fourth of the way from the apex forward internally there was a thickened ridge or line which leaves a perceptible trace on the internal cast.

Genus **ATYS** Montfort.

Atys Sandersoni Dall.

A. Sandersoni Dall, Bull. Mus. Comp. Zoology, ix. p. 99, 1881; xviii. p. 54, pl. xvii. fig. 7, 1889.

This species has been received from the Pliocene of the Caloosahatchie and Shell Creek, collected by Willcox and Dall. It is found living from Cape Hatteras southward through the Antilles, living in 8–40 fathoms, though occurring dead in dredgings from deeper water.

FAMILY BULLIDÆ.

Genus **BULLA** Linné.

Bulla striata Bruguière.

This well-known species is found living as far north as Charlotte Harbor on the west, and as Jupiter Inlet on the east coast of Florida; also on the coast of Texas; but its presence on the western shores of Florida north of

Charlotte Harbor and thence to Texas, though not unlikely, remains to be demonstrated. It is, however, abundant in Post-Pliocene deposits as far north as Tampa Bay. It was found at North Creek by Mr. Willcox. I have received it from the Pliocene beds of the Myakka River and Shell Creek, and it is especially abundant with *Venus* (*Chione*) *cancellata* in the upper layers of the Caloosahatchie Pliocene, which were deposited in shallower water than the lower layers, in which it is also found, but more sparingly. I have not been able to determine the presence of the allied *B. occidentalis* Adams in a fossil state. The specimens of *B. striata* frequently retain well-marked traces of their original color pattern, which is the same as in recent specimens. *B. paupercula* Sby. and *B. Vendryesiana* of the Miocene of Jamaica and Haiti are stated by Dr. Guppy to be synonymous with varieties of this species.

Bulla petrosa Conrad.

Bulla petrosa Conrad, Am. Journ. Sci., 2d Ser. ii. p. 399, with figure, 1846. (Tampa silex-bed.)

Not *Bullina petrosa* Conrad, *l. c.*, v. p. 433, 1848= *Cylichna* sp. *fide* Meek. (Miocene, Astoria, Oregon.)

Tampa silex-beds at Ballast Pt.; Conrad, Dall.

This is a genuine *Bulla*, like *B. solida*, but of smaller size, the apex being perforate. My specimens are too imperfect, or imbedded in solid silica, to do more than confirm its occurrence here.

Genus **HAMINEA** Leach.

Haminea virescens Sowerby.

Bulla virescens Sowerby, Genera, No. XXXIX., fig. 2.

Haminea virescens A. Adams, Thes. Conch., II. p. 579, pl. 124, fig. 83, 1850.

Haminea cymbiformis Cpr., Mazatlan Shells, p. 174, 1857.

Caloosahatchie beds. Recent on the Pacific coast, and widely distributed over the warm seas.

The specimens have been compared with typical specimens of *H. virescens* and agree exactly. This is one of the cases where, so far as known, a species formerly inhabiting both coasts of North America has become extinct since Pliocene times on one side of the continent while persisting on the other. It is quite possible, however, that a more thorough exploration of the Antillean region would show the species still living there.

FAMILY APLYSIIDÆ.

Genus **DOLABELLA** Lamarck.

Dolabella Aldrichi n. s.

Plate 10, fig. 7 a.

Shell large, thick, subspiral, of about (when perfect) one and a half whorls; apex showing signs of the existence of a wing-like appendage, as in other species of the genus; exterior smooth or slightly transversely waved, with a shallow sulcus outside the cycloidal pillar, vertex with a spirally grooved or irregular surface; pillar with a flattened or roughly sulcate face below, rounded above; interior smooth; shell widening as it grows, the edge imperfect in the specimens; height 28; breadth (broken) 25; thickness of shell up to 5.0 mm.

Lower Miocene shell-bed, Alum Bluff, Western Florida.

This is the first species of the genus described from our Tertiaries, and recalls the original type *D. Rumphii*, which is, however, less spiral and regular in form.

FAMILY TESTACELLIDÆ.

Genus **GLANDINA** Schumacher.

Glandina truncata Gmelin.

Glandina truncata Binney, Terr. Moll. U. S., II. p. 301, plates lix., lx.

Caloosahatchie beds, not common; Dall, Willcox.

Glandina truncata var. **ovata.**

Caloosahatchie beds, one specimen; Dall.

Glandina truncata var. **macer.**

G. truncata var. W. G. Binney, Terr. Moll. U. S., IV., plate lxxx., figure 9, 1859.

Caloosahatchie beds, one specimen; Dall.

The above are doubtless varieties of one species, though very different in proportions. They measure, respectively, 64 x 22.5 mm; 44 x 25 mm; and 75 x 20 mm.; the color, sculpture and number of whorls being the same. Precisely the same variations occur in the living specimens of the same region at the present day.

FAMILY HELICIDÆ.

Genus **HELIX** Linné.

Subgenus **Polygyra** Say.

Polygyra cereolus microdonta Dall.

P. cereolus microdonta Dall, Proc. U. S. Nat. Mus. 1885, p. 266, 1885.

Rare in the Caloosahatchie beds; Dall.

I believe that the upper layers of the Caloosahatchie beds were deposited in shallow fresh-water lagoons with little dry land in the vicinity. That only three specimens of shells strictly belonging to the dry-land fauna should have been found among the thousands of fresh-water shells, though terrestrial *Pulmonata* were specially searched for, I regard as strong evidence in favor of the belief mentioned. *Glandina* and *Succinea* are not exceptions to the case, for they both frequent wet situations.

FAMILY SUCCINEIDÆ.

Genus **SUCCINEA** Draparnaud.

Succinea luteola Gould.

S. luteola Gould (1848), Binney, L. and F. W. Shells N. Am., I., p. 261, fig. 466, 1869.

One specimen in the Caloosahatchie marl.

FAMILY LIMNÆIDÆ.

SUBFAMILY PLANORBINÆ.

Genus **PLANORBIS** Guettard.

Planorbis Conanti n. s.

Plate 10, figures 1, 1 a.

Caloosahatchie marl; not uncommon in the lower beds, more and more abundant toward the top, excessively numerous in the uppermost layer, and forming, with the next species, the most conspicuous fossil in the thin bed of silicified mud which covers the marl-beds near Fort Thompson on the Caloosahatchie and extends to Tampa Bay, where it has been dredged up from the ship channel off Ballast Point in large masses.

Shell large, flattish, sinistral, six-whorled; sculpture of fine transverse grooving, feebler on the later whorls, especially toward the periphery; spire with the whorls not carinated, except possibly some of the earlier ones and these but rarely; the upper surface has the angle outside of the suture rounded over with the sutural slope steep, the other nearly horizontal, then rounding downward; the highest part of the whorl is at this angle; lower surface of the whorls rather evenly rounded between the sutures and not markedly depressed toward the centre; four or five of the six or seven whorls composing the shell are plainly visible; the suture deep and prominent on the base; strongly marked but less deep on the summit of the shell; aperture very slightly inflated, its base not descending in normal specimens below the plane of the base of the shell, and above hardly rising above the plane of the last whorl; it is very oblique, sharp-edged, the lower edge preceding, with a thin callus over the body, and no campanulation. Max. diam. of shell 27.0; min. diam. 21.0; alt. 10.0 mm.

This shell is nearest *P. Duryi* Wetherby, and may be distinguished from it by the following characters: It is larger than *P. Duryi* and proportionally flatter; when *P. Duryi* is viewed in profile the rounding of the shell from the periphery is notably symmetrical; in *P. Conanti* the base is rounded, the upper surface more obliquely flattened and with the highest part nearer the suture and the sutural descent of the whorl more abrupt; *P. Conanti* has one more whorl than *P. Duryi*, and has two more whorls visible on the base, which has not the central funnel-shaped umbilicus of *P. Duryi*. This last is perhaps the most obvious character on a hasty examination. It will also separate *P. Conanti* instantly from *P. lentus* and the various forms of *trivolvis*.

This species is named, at the request of Mr. Joseph Willcox, in honor of Mr. Sherman Conant, General Manager of the Florida Southern Railway, to whom we are under obligations for courtesies extended which much facilitated the work of exploration.

This shell is subject to extraordinary deformities, and sometimes, even in rather small specimens, will show seven well-formed normal whorls on the upper surface.

I should add that the last whorl increases in size less rapidly than in *P. Duryi* and forms a somewhat smaller proportion of the surface, viewed from above.

Planorbis Disstoni n. s.

Plate 10, figures 2, 2 a.

Shell large, thin, carinated above, high, with five and a half whorls, of which two and a half to three are visible on the base; sculpture of the usual transverse elevated lines in harmony with the lines of growth; upper surface of whorls carinated to or nearly to the aperture, slope from the carina to the suture not very steep, nuclear whorls rather deeply sunken; periphery rather evenly rounded; base subangular, central perforation deep; suture well marked, not very deep; aperture in perfectly normal examples, extending below the plane of the base and above the plane of the upper side, enlarged, hardly campanulate; callus on the body and outer lip somewhat thickened; last whorl rather rapidly increasing in height compared with the last species. Max. diam. 22.0; min. diam. 17.0; alt. 10.5 mm.

This shell differs from all the *trivolvis* group, to which it belongs, in having one more whorl, and in having on the base one more visible whorl. It is variable and frequently distorted, so that perfectly normal specimens are rather the exception. It differs from *P. Conanti* (which is more related to *glabratus* and *Duryi* than to *trivolvis*), in its greater proportional height, its more rapidly expanding whorls, its carination on the spire and its somewhat sharper sculpture. Some of the specimens vary in the direction of *P. Conanti* in a way which suggests hybridization, but when full-grown and with a normal development they are immediately separable from one another by the greater height of *P. Disstoni.* This species is rather more abundant in the marls than *P. Conanti* and less so in the silicified mud of the *Planorbis* bed, above them. It is named in honor of Mr. Hamilton Disston, president of the Okeechobee Land and Canal Co., to whom we are indebted for assistance in the exploration of the Caloosahatchie beds, through the facilities possessed by the company in that region.

Planorbis exacutus Say.

P. exacutus Say, Binney, L. & F. W. Sh. N. Am., II. p. 126, f. 210, 1865.

Caloosahatchie beds, rather rare; Dall, Willcox.

This species still lives in the region and extends in the United States over the greater part of the Atlantic watershed.

Genus **ISIDORA** Ehrenberg.

Subgenus **Ameria** H. & A. Adams.

Thomsonia Ancey, 1888, not of Signoret, 1879 (*Hemiptera*).

Ameria scalaris (Jay) Dall.

Paludina scalaris Jay, Cat., 3d Ed., p. 112, plate i. figures 8, 9, 1839.
Physa scalaris Haldeman, Mon. Limn., p. 34, plate iv. figure 9, 1842.
Ameria scalaris Dall, Ann. Lyc. N. H. N. Y., ix. p. 356, 1870.
Physa (*Thomsonia*) *carinifera* Ancey, Le Naturaliste, Paris, 1888.
Helisoma scalaris Pilsbry, Conch. Exch., II. p. 113, 1888; III. pp. 41, 43, 1889.

Caloosahatchie beds, rare; Dall. Post-Pliocene of St. John's River, Florida, common; living in South Florida, not uncommon in small ponds and rivulets at midsummer.

Isidora is a *Planorbis* with elevated spire; it may be either sinistral or dextral, smooth or sculptured. For the forms with carinated whorls and sinistral shells Adams proposed the subgenus *Ameria*. Whether the Floridian shell is strictly pertinent to this group can only be finally decided when the form of the tentacles and the dentition are fully known. At all events, it has nothing in common with *Physa* except its sinistrorsity. I have never been able to obtain a description of the animal or alcoholic specimens with the soft parts, and would be greatly indebted to any correspondent who would assist me to obtain them.

The genus *Isidora* has been referred to *Bulinus* Adanson as a synonym, but as Adanson was not a binomial writer, his name cannot be sustained against one properly proposed. Adanson's shell was not congeneric with *Physa hypnorum* and other shells commonly referred to *Bulinus*.

FAMILY PHYSIDÆ.

Since my establishment of this family twenty years ago, by pointing out its anatomical characters and especially its remarkable dentition, it has been universally adopted by writers on the subject. It is impracticable to distinguish between the species with an entire mantle-edge and those which have it fringed, when we possess only fossil specimens.

Genus **PHYSA** Draparnaud.

Physa Meigsii n. s.

Plate 10, figure 12.

Shell large, with six or seven polished whorls; spire acute, whorls flattish and appressed, the suture somewhat irregular, but closely appressed in all cases; length of spire to that of the last whorl as 5.5 to 40; surface of the whorls brilliantly polished, when perfect; on the last whorl the incremental lines are somewhat fasciculated at the suture and indicate obscure waves across the whorl, beside which the surface is covered, except on the periphery, with microscopic, close-set silky striæ; near the suture on the last whorl and on all of the spires, in specimens with the surface perfectly preserved, by means of a good glass a fine, uniform waving of these striæ is observable which gives a very elegant shagreened effect to the surface, different from that of the large recent species to which this fossil has been casually referred; the last whorl is full and plump, but with the periphery somewhat flattish, giving a somewhat cylindrical effect; the aperture is two-thirds as long as the shell, rather narrow; body with a well-marked callus in adults; pillar with a well-marked twist. Lon. of shell 40, of aperture 27.0; max. lat. of shell 20.0 mm.

This fine species sometimes retains traces of dark yellow-brown spiral bands on the spire such as are figured by Fischer and Crosse in *Aplexa impluviata* and *A. bullula* (Exp. Sci. Mexique, Zool., part 7, pl. 39 figs. 5, 6 a) of Mexico. The body of the shell seems to have been of a rich orange-brown, if one may judge by the tint remaining.

At first sight, by the size and acute apex of this shell, the large recent species of Mexico, *Aplexa aurantia* Carpenter or *Maugeriæ* Gray, is brought to mind; but a comparison of specimens shows that they have little in common. Neither do the other Mexican species now living show any great similarity. Though the genus is one noted for mutability, the specimens collected from the Caloosahatchie marls, where they are abundant, associated with *Planorbis Conanti* and *P. Disstoni*, are remarkably uniform in character, though few attain quite the dimensions above noted. Some large fossil *Physas* from Vera Cruz, Mexico, referred by Messrs. Crosse and Fischer to *Aplexa nitens* Philippi var. *gigantea*, are more like our shells than the recent *nitens*, though the Vera Cruz fossil is of a different shape from ours. On the whole, among fossil forms, *P. Meigsii* approaches *Physa bridgerensis* Meek, from the Laramie, as nearly as any. But compared with a well-grown *P. heterostropha* of the slender type, the fossil is seen to reproduce almost precisely the outlines of the recent shell, but on a comparatively gigantic scale. The evidence for its relations is thus seen to be indecisive, and it may quite as well be a true *Physa* of the *heterostropha* type as an *Aplexa*.

As it does not in the sum of its characters coincide with any described species, though united to several of them by single characters, I have thought best to give it a distinctive name, especially as it is a prominent member of the fauna in the Caloosahatchie Pliocene.

There is a rare variety of this species with a short spire, of which two or three specimens were collected, but which exhibits the same microscopic shagreening as the typical form.

It is named, at the suggestion of Mr. Joseph Willcox, in honor of Mr. Wm. M. Meigs, of Philadelphia, who accompanied Mr. Willcox in his explorations of 1889 and materially assisted in promoting their success.

SUPERORDER STREPTONEURA.

Order CTENOBRANCHIATA.

Superfamily TOXOGLOSSA.

FAMILY TEREBRIDÆ.

Genus **TEREBRA** Bruguière.

Section *Acus* (Humphrey) Gray.

Terebra (Acus) dislocata Say.

Cerithium dislocatum Say, Journ. Acad. Nat. Sci. Phila., II. p. 235, 1822.
Terebra Petitii Kiener, Mon. Ter., p. 37, plate xiii. figure 32, 1838.
Terebra rudis Gray, P. Z. S., 1834, p. 60.
Terebra dislocata Holmes, Post-Pl. Fos. S. C., p. 70, plate xi. figure 12, 1858.
Terebra carolinensis (Conrad, *ex parte*) Holmes; *op. cit.*, p. 70.
Terebra dislocatum Emmons, Rep. N. Car. Geol. Sur., p. 257, 1858.

Habitat, Eocene of Mississippi (var. *tantula* Conr.); Miocene of Virginia, North Carolina and of Ballast Point silex-beds, Florida; Pliocene of the Carolinas; Caloosahatchie beds; Post-Pliocene of the whole coast from Maryland southward. Recent from Maryland southward to Florida, the Bahamas and Venezuela.

This well-known form indulges in many variations and has a dwarf variety which indulges in a parallel series of variations. Some of its examples agree exactly with Eocene specimens of *T. tantula* Conrad; and specimens which have been identified by good authorities with *T. divisura* Conrad, though not the typical form of that species, are critically close to some of the recent shells. The specimen from Ballast Point is about half way between *T. tantula* and *T. protexta*. Miocene specimens from South Carolina are before me, agreeing exactly with the large typical *dislocata* var. *rudis*. Among the recent shells any one of the variations above noted can be duplicated.

Terebra (Acus) concava Say.

Turritella concava Say, Journ. Acad. Nat. Sci. Phil., V. p. 207, 1827; De Kay, N. Y. Moll., p. 113, 1843.
Cerithium concavum Ravenel, Cat. 14, 1834.
Acus concavus Dall, Rep. Blake Gastr., II. p. 63, 1889.

Caloosahatchie beds, not uncommon.

This species varies greatly. It has a stout form and a slender form. Both of these have varieties with weak and with strong sculpture. The typical form of *concava* has a strong nodulous rib on each side of the suture, with the middle of the whorl constricted and sculptured with fine spiral lines. This appears very distinct, but graduates toward the dwarf form of *T. dislocata* and the finely sculptured form of *T. protexta* when a sufficient number of specimens from a large range of coast are compared. The fossil specimens vary in exactly the same way that the recent ones do.

Terebra (Acus) protexta Conrad.

Cerithium protextum Conrad, Proc. Acad. Nat. Sci. Phila., iii. p. 26, 1845. Mörch, Malak. Blätt., xxiii. p. 121, 1877.

Acus protextus Dall, Rep. Blake Gastr., pp. 63, 65, 1889.

Miocene of the Carolinas and Florida; Pliocene of South Carolina and Caloosahatchie beds of Florida; Post-Pliocene of North Carolina and Florida. Recent on the coast of the United States from Cape Hatteras south to Florida and west to Texas, in 2 to 50 fathoms weedy bottom.

It is almost impossible to separate the varieties of *T. protexta*, *T. concava*, etc., from each other or from the fossil forms previously referred to, when a full series is examined. They intergrade almost without limit.

Terebra constricta H. C. Lea.

T. constricta H. C. Lea, Am. Journ. Sci., xl. p. 100, plate i. figure 18, 1841.

On an examination of the type of this species from the Claiborne sands, it turns out to be a trilineate *Cerithiopsis* or *Seila*, very closely related to *S. terebralis* C. B. Adams, of the recent fauna.

FAMILY CONIDÆ.

Genus **CONUS** Linné.

Conus planiceps Heilprin.

Plate 11, figures 5, 5a.

Conus planiceps Heilprin, Trans. Wagn. Inst. I. p. 110, fig. 48.

This species appears very uniform in its characters, and sufficiently distinct from *C. haitensis* Sowerby. I have seen no other species from the silex-beds at Tampa, while this is sent from Martin Station, about twelve miles north of Ocala, Florida, by Mr. Willcox, in a silicified rock, apparently referable to the Vicksburg horizon of Upper Eocene age. The Eocene *Conus sauridens* Conrad is closely related to this species.

Conus cruzianus n. s.

Plate 5, figure 12.

Shell elongate pyriform, thin, deeply spirally sulcated; whorls ten or twelve, apex acute, arising from a spire but little elevated, and having its slope concave in profile; sides of the shell with about twenty deep, uniform rounded sulcations, separated by slightly narrower cords; anteriorly these cords are rounded and finely striated spirally, midway they are a little flattened, and near the spine they are even marked with a shallow median sulcus; the channels are not striate between the cords, or but in the faintest manner; sides of the shell slightly swelling, falling away toward the spire, which is rounded at the margin, striated with fine distinct threads, and with a narrow striated channel close to and in front of the suture; transversely the sculpture is only of lines of growth, which cover the whole shell, but are not prominent; aperture narrow, especially behind, posterior angle hardly notched, pillar straight, simple. Max. lon. of shell 27.5; of aperture 23.0; max. lat. of shell 13.3 mm.

White Tertiary (Pliocene?) limestones of the Island of Santa Cruz, West Indies.

This shell, now pure white, retains traces of yellow flammules on the spire, radiating from the apex, and irregular yellowish blotches on the sides.

This species is of entirely different form from *C. planiliratus* Sowerby, *C. gracilissimus* Guppy, *C. aratus* Gabb and other Antillean sulcate cones. *C. Bonaczyi* Gabb has also a widely different form, with the spire unstriated. I judge of Gabb's species, of course, by his types at Philadelphia, as the fossils have never been figured. I have had this species for a long time, and take this opportunity of figuring it.

Conus adversarius Conrad.

Conus adversarius Conrad, Am. Journ. Sci., vol. xxxix. p. 388, 1840; vol. xli. p. 345, pl. 2, fig. 3, 1841. Tuomey & Holmes, Pleioc. Foss. S. C., p. 131, pl. 27, fig. 14.

Conus Tryoni Heilprin, Trans. Wagner Inst. I. pp. 82, 133, figs. 10, 75, 1887.

Miocene of North Carolina (Conrad); of Maryland (Meek); Pliocene of South Carolina (Tuomey & Holmes); Caloosahatchie beds (Heilprin, Willcox, Dall, Burns and others).

A larger series than was available to Prof. Heilprin when he renamed this species, has enabled me to conclude that *C. Tryoni* is merely the full-grown and most perfect form of *C. adversarius.* The shell is remarkably variable in form and in its sculpture, which, never very strong, may be almost absent; the spire may be faintly coronated with tubercles on the carina or plain, the carina may be sharp or gently rounded. Conrad's original figure is defective in making the spire revolve in a nearly horizontal plane as in a dextral shell, whereas it is always more oblique.

Conus proteus Hwass.

Conus proteus Hwass, Encycl. Meth., vers. i. part 2, p. 682, 1789. Tryon, Man., vi. p. 12, pl. 2, figs. 30–35, 1884.

Conus Berghausii? Gabb, Am. Phil. Trans. xv., 1873, p. 232 (not of Hoernes, Foss. Wiener beck., pl. i. fig. 3).

Conus Mercati? Heilprin, Trans. Wagn. Inst. I. p. 83, 1887 (not of Hoernes, Brocchi, etc.).

Specimens collected by me on the Caloosahatchie retain the colors sufficiently to leave no doubt as to their affinities with the recent cones of the Florida coast and Antilles, with which they absolutely agree otherwise. I have not seen Gabb's shells, but have no doubt they should also be referred to *Conus proteus*, which for that matter has many other synonyms, and is generally supposed to be Gmelin's doubtful *Conus spurius.*

Conus Pealii Green.

Conus Pealii Green, Trans. Albany Inst. i. p. 123, pl. 3, fig. 3, 1830.
Conus Stearnsii Conrad, Am. Journ. Conch. V. p. 104, pl. 10, fig. 1, 1869.
Conus planiliratus Gabb, *op. cit.*, p. 230; not of Sowerby or Guppy.

Recent on the Florida coast and northward to the Carolinas. Fossil, Caloosahatchie beds.

As Mr. Gabb observed, it is almost impossible, without the color-markings, to identify cones; and, therefore, identifications must always be taken as approximate. But I cannot join him in uniting *C. Pealii* with Sowerby's much larger and coarser species. The identification, from Green's specimens, of *C. Pealii* and *C. Stearnsii*, was made by Dr. Stimpson; from the description alone one would suppose Green was dealing with a young specimen of *C. pygmæus* Reeve or some other species. However, the species now known as *C. Pealii*, as reinstated by Stimpson, would keep its name at any rate, since Green's name is much older than Sowerby's. It is probable that the shells referred to *C. planiliratus* by Mr. Gabb included specimens of several species, but *C. Pealii*, not being known from the Antilles, was probably not one of them. The Caloosahatchie shells in form and sculpture agree absolutely with fresh specimens of *C. Pealii*, so I cannot refer them elsewhere.

Conus centurio, *C. Delessertii*, *C. flavescens* and *C. floridanus*, deprived of color, cannot be specifically separated from each other. In the recent state the forms are easily recognizable, and by comparison of a large number of specimens one can generally recognize a certain facies, undefinable but existent, which gives probability to one's identification of the colorless fossils.

Conus floridanus Gabb.

Conus floridanus Gabb, Am. Journ. Conch. IV. p. 195, pl. 15, fig. 4, 1868.
Conus floridensis Sowerby.

This species differs from the fossil *C. marylandicus* Green chiefly in its greater anterior attenuation and straighter sides. A number of specimens which seem properly referable to it were obtained from the Caloosahatchie beds. The recent form is found as far north as Cape Hatteras, but is not known from south of the Florida Keys.

Conus pygmæus Reeve.

Conus pygmæus Reeve, Conch. Icon. *Conus*, fig. 260, 1843.

Caloosahatchie beds. The recent form ranges from Florida southward to New Grenada and among the Antilles. The fossils referred to this species sometimes retain indications of their color-pattern. They are shorter, stouter, more squarely and generally channeled than *C. Pealii* and the channels are crossed by elevated lines of growth not visible elsewhere.

Conus daucus Linné.

Young specimens (to 25.0 mm. long) were found in the Caloosahatchie beds, which, after careful comparison, seemed referable here. The line of relationship connecting the Eocene *Conus sauridens*, the Miocene *C. planiceps* and the present fossil specimens, seems to culminate in the recent specimens of *C. daucus*, which, with many similar characters, reach a size and development somewhat superior to any of their precursors.

Conus sp. indet.

Casts of a species of *Conus* were obtained at White Beach, indicating a species larger than any of the recent species of the region, with a very flattened spire, the apex being slightly raised, the whorls smooth and convexly rounded, with deep sutures; sides of the shell straight and smooth (unless near the canal, which is broken); whorls about 14. Max. diam. of internal cast 47.0, lon. (est.) 75.0 mm.

This form, though larger, resembles most the largest flat-spired variety of *Conus papilionaceous* Hwass, now living in Floridian waters.

FAMILY PLEUROTOMIDÆ.

Genus **PLEUROTOMA** Lamarck.

Pleurotoma albida Perry.

Plate 4, figure 8 a.

Pleurotoma albida Perry, Conch., expl. pl. xxxii. fig. 4, 1811. Dall, Blake Report, Gastr., p. 72, 1889.

Pleurotoma haitensis Sowerby, Quart. Journ. Geol. Soc. vi. p. 50, 1849.

Pleurotoma Barretti Guppy, Quart. Journ. Geol. Soc. xxii. p. 290, pl. xvii. fig. 6, 1866. (Miocene, Santo Domingo.)

Pleurotoma cochlearis Conrad, Journ. Acad. Nat. Sci. Phil., 2d ser. 1, p. 115, pl. xi. fig. 23 (bad), 1848.

Pleurotoma virgo Lamarck.

Later Eocene of Vicksburg, Mississippi; Miocene of Western Florida, Santo Domingo and Borden, Jamaica; silex-beds of Ballast Point, Tampa Bay, Florida; Pliocene marls of Caloosahatchie River, Florida; recent, in the Gulf of Mexico and the Antilles, in 26 to 125 fathoms.

This is a remarkable species. Its genealogy is complete for a period which it would be difficult to estimate in terms of years. The Eocene specimens agree exactly with recent specimens of the same size, and vary within the same limits. It is very probable, however, that they never attained the size of some of the recent specimens. Conrad's figure is incredibly bad, but I have compared authentic specimens of the fossils.

Pleurotoma servata Conrad.

Pleurotoma servata Conrad, Jour. Acad. Nat. Sci. Phila., 2d ser. 1, p. 115, pl. xi. fig. 18 (poor), 1848.

Later Eocene of Vicksburg, Mississippi; Miocene of Ballast Point silex-beds, Tampa Bay, Florida.

Several more or less broken pieces and defective specimens agreeing with those named *servata* by Conrad were obtained from the silex-beds.

Genus **DRILLIA** Gray.

Section *Cymatosyrinx* Dall.

Drillia lunata Lea.

Pleurotoma lunatum Lea, Trans. Am. Phil. Soc., new ser. ix. p. 269, pl. 37, fig. 93, 1843.
Drillia lunata Conrad, Proc. Acad. Nat. Sci. Phila., 1862, p. 562.
Drillia (*Cymatosyrinx*) *lunata* Dall, Rep. Blake Gastr., p. 95, 1889.

Miocene of Petersburg, Virginia and Chipola River, West Florida; Pliocene of the Carolinas, Caloosahatchie beds of Florida.

This fine species is not rare in the Caloosahatchie marls. It does not appear to have survived to the present day, but is represented by *D. æpynota*, *D. Moseri*, and other allied but distinct species. In the Floridian Miocene other species of the same type existed, but smaller, of which the following will serve as an example.

Drillia Newmani n. s.

Plate 4, figures 5, 5a.

Shell small, seven-whorled, with a small, smooth nucleus of two whorls; the remainder is transversely sculptured by (on the last whorl eleven) very uniform, rounded, moderately elevated, slightly sigmoid ribs or waves, which are most prominent on or just behind the periphery of the whorls, which do not cross the anal fasciole and on the base become gradually obsolete; the spiral sculpture is hardly visible except on the last whorl, and consists of fine rounded threads, most evident on the base and canal, and fading as they recede from the base; anal fasciole smooth, rather wide, unsculptured except by incremental lines; suture appressed over the ribs of the preceding whorl, and thus rendered slightly wavy; last rib varicoid; canal short, wide; outer lip not internally lirate; inner lip concave, simple, with a moderate callus. Max. lon. of shell 12.5; max. lat. 4.8 mm.

Ballast Point silex-beds, Tampa Bay, Florida; Newman.

This species may best be compared with *D. æpynota* (Rep. Blake Gast., pl. xxxvi. fig. 10), than which the shell is proportionally more slender, with smaller, shorter and less prominent ribs, narrower and less excavated anal fasciole, and smaller nucleus. It is also a smaller shell than the small varieties of *D. æpynota* and much less stout and swollen in appearance.

Drillia æpynota Dall var. **acila.**

Drillia (*Cymatosyrinx*) *æpynota* Dall, Rep. Blake Gastr., p. 96, pl. xxxvi. fig. 10, 1889.

Caloosahatchie beds. Recent off the coast of the Carolinas in 25 to 120 fathoms.

The fossils differ from the recent shells in having the spire slightly more drawn out and acute, the anal fasciole consequently wider and more marked and the crests of the ribs a little sharper-edged. The differences are hardly greater than are observable between recent individuals, but for those who insist upon them the fossils may form a variety *acila*.

Drillia eburnea Conrad.

Drillia eburnea Conrad, Proc. Acad. Nat. Sci. Phila. XIV. pp. 285, 562, 1863. Smithsonian Checklist Inv. Foss. N. Am. Miocene, p. 21, 1864. (Not of Bivona or Carpenter.)

Miocene of Maryland (and Virginia ?). Caloosahatchie beds.

From a specimen of Conrad's unfigured species I have identified two not completely adult specimens from the Caloosahatchie marl.

The shell resembles *Pleurotoma ebur* Reeve, but is more slender, with a less marked anal fasciole and an elevated line in front of the suture. *P. eburnea* Bivona is a *Mangilia*. Carpenter's species only dates from 1865 and may take the name of *D. eburneola* Dall.

Drillia Moseri Dall.

Drillia (*Cymatosyrinx*) *Moseri* Dall, Rep. Blake Gastr., p. 97, pl. xxxvi. fig. 3, Feb., 1889.

Fossil in the Caloosahatchie beds. Recent, from North Carolina to the Florida Keys, in 3 to 50 fathoms.

The recent and fossil specimens agree in all respects. I may add that *Pleurotoma limatula* Conrad belongs to this section of the genus *Drillia*.

Drillia pagodula Dall.

Drillia pagodula Dall, Rep. Blake Gastr., p. 90, pl. xiii. fig. 6, Feb., 1889.

Caloosahatchie beds. Recent, in Floridian and Antillean waters, in 50 to 175 fathoms.

This species belongs to the group of *Pl. ebur* and *fucata* Reeve and looks like a very dwarf race of *D. Moseri*.

Section *Drillia* s. s.

Drillia ostrearum Stearns.

Drillia ostrearum Stearns, Proc. Boston Soc. Nat. Hist. XV. p. 22, 1872; Dall, Hemphill's Shells, p. 328, in Proc. U. S. Nat Mus. VI. 1883. Tryon, Man. VI. p. 197, pl. 34, fig. 79, 1884.

Miocene of Chipola, West Florida, and the silex-beds of Ballast Point, Tampa Bay, Florida; Pliocene, Caloosahatchie beds. Recent, from North Carolina to Florida and Yucatan, between low-water mark and 15 fathoms.

This species is the recent prototype of a large number of forms extending back to the Eocene. It is frequently difficult to decide what value to assign to mutations occurring in different beds which, among the shells of one locality and geological horizon, would be very generally considered not to rise above varieties of one species. My own impression is that they should not be regarded as of higher grade than subspecies. They would agree very well with the ornithological subspecies, the genetic connection taking the place of geographical continuity. The recent representative or the latest fossil form should preserve the stem-name because of the much greater opportunity of determining its relations to the rest of the fauna and therefore, by implication and analogy, that of the fossil representatives.

The present species varies in stoutness or slenderness and in the strength or weakness of the individual components of its sculpturing. The latter may vary singly or in unison, and the number of combinations, even when color is left unconsidered, is truly remarkable, as any one may verify by a very simple mathematical calculation. It is a matter of taste how many of these combinations should be named.

Drillia abundans Conrad.

Pleurotoma (*Clavatula*) *abundans* Conr., Journ. Acad. Nat. Sci. Phila. I., 2d ser., p. 115, pl. xi. fig. 25, 1848.

Drillia abundans Conr., Am. Journ. Conch. I., p. 19, 1865.

Later Eocene of Vicksburg, Mississippi; Pliocene of the Caloosahatchie beds.

When fully developed this species is about an inch long, with 12 to 14 sharp-edged ribs on the last whorl, a faintly internally lirate outer lip, and about a dozen rather prominent spiral threads with much finer spiral striæ in the wide interspaces ; the most characteristic feature is the double oblique rippling of a narrow band in front of the suture as it passes over the ribs of the preceding whorl. It seems to be rare in the Caloosahatchie beds, and is not known in a recent state. It is one of the most ancient representatives of the *ostrearum* type.

Drillia abundans var. **perrugata** Dall.

Caloosahatchie beds, not rare.

This form differs from the type by attaining a greater size, by its more inflated whorls, by having nearly twice as many ribs, which are consequently weaker, by its coarser and closer spiral threading, its less excavated and more wrinkled anal fasciole, and the absence of liræ in the throat. I have received some recent specimens from the Mexican coast which approach it very closely. It reaches a length of 29.5, and a width of 8.0 mm.

Drillia alesidota var. **perspirata** Dall.

Drillia alesidota Dall, Rep. Blake Gastr., pp. 84, 85, pl. xxxvi. fig. 1, 1889.

Caloosahatchie beds.

This form differs from the recent type and its var. *macilenta* in its shorter whorls, its proportionally greater stoutness, coarser and rounder spiral sculpture, more constricted anal fasciole and stronger and more angular band between the fasciole and the suture. The number of whorls is about the same in both. The maximum length of the fossil is about 29.0, and its width 10.0 mm.

Drillia acurugata n. s.

Plate 2, figure 12.

Caloosahatchie beds, one specimen.

Shell strong, with nine or ten whorls beside the smooth nucleus; spiral sculpture of fine scratches on the fasciole, sharp, usually paired, grooves on the body with wider and alternately broad and narrow rounded interspaces which are subnodulous in the line of the transverse ribs; these nodulations are higher on the posterior margin of the interstitial bands, so that with the canal pointing vertically the base of the shell looks like a tiled roof on a cupola; there is a moderately elevated round thread in front of the suture and more or less undulated by the ends of the ribs behind it; on the siphonal fasciole there are a few fine threads; transverse sculpture of (on the last whorl fifteen) moderately elevated ribs, beginning and strongest on the shoulder of the whorl and fading away anteriorly near the canal; on the base they are slightly nodulous between the spiral grooves; anal fasciole excavated but slightly undulate behind the ribs and marked by fine incremental lines; notch not deep but distinct and U-shaped; canal short, wide; aperture rather narrow, with a moderate callus on the pillar and no liræ on the outer lip. Max. lon. of shell 21.2; max. lat. 8.0 mm.

This is nearest to *D. abundans* and the preceding, but is less drawn out and has a sharper and different sculpture.

Drillia acucincta n. s.

Plate 2, fig. 11.

Caloosahatchie beds; rare.

Shell thick and solid, short-fusiform, strongly sculptured; whorls about ten; spiral sculpture undulated by the ribs and comprising a single very small thread at the suture separated by a shallow gutter from a very strong, sharp and elevated waved keel; in front of this is the wide, deep anal fasciole; then come (on the upper whorls two or three, on the last whorl eight) strong, uniform sharp threads separated by wider, uniform interspaces; then the canal with rounder, smaller crowded threads; between the primaries is fine uniform spiral striation, fainter on the fasciole; transverse sculpture of (on the last whorl seven) strong, rounded ribs, broadest at the shoulder and extending to the constriction behind the canal, with narrower interspaces; there is also more or less fine transverse striation caused by the strong incremental lines; the last rib is swollen and varicose; notch short, rounded; body-callus well developed with a posterior nodule opposite the notch; outer lip sharp, arcuate; throat without liræ; canal short, shallow; an umbilical chink behind the callus on the pillar; aperture narrow. Max. lon. of shell 20.0; max. lat. 8.2 mm.

Only two specimens of this strongly marked species were obtained from the marl.

Drillia ebenina Dall.

Plate 2, figure 8.

Miocene of Santo Domingo (Gabb); Pliocene of the Caloosahatchie beds. Recent on the shores of the Gulf of Mexico, from Florida to Vera Cruz.

Shell stout, fusiform, spire acutely pointed, color (in the recent form) dead black, fading to very dark reddish brown; whorls eleven, of which two belong to the smooth dark brown nucleus, which is minute; last whorl more than half the shell; transverse sculpture (on the last whorl fifteen, beside the varix) sharp, slightly elevated flexuous ribs, with much wider interspaces, abrupt and largest where they begin in front of the fasciole and growing less conspicious to the canal; incremental lines perceptible, but not strong; varix large, rounded, swollen; spiral sculpture of fine, uniform threads, with wider interspaces, becoming coarser on the canal and more close-set toward the suture; these do not cut or nodulate the ribs on the periphery, but are well marked between them; behind the anal fasciole is a sharp, even keel with a space between its edge and the margin of the suture; suture inconspicuous, slightly appressed; aperture short, narrow; throat smooth; canal short, wide; pillar straight, with no umbilical chink and very little callus except opposite the notch; notch circular, subtubular, nearly closed in front, not as wide as the fasciole. Max. lon. of shell 16.5; of aperture 7.0; of last whorl 10.0; max. lat. 6.5 mm.

This fine species was first found living in shallow water on the Florida Keys, by H. Hemphill. I find specimens of it together with several other species confused together under the name of *Jamaicense* Guppy in the Gabb collection at Philadelphia.

Drillia quadrifasciata Gray.

Pleurotoma quadrifasciata Gray, Reeve, Conch. Icon., *Pleurotoma*, pl. xxviii. fig. 251, Dec. 1845.
Pleurotoma quadrilineata C. B. Adams, Cont. to Conch., p. 64, 1850.
? *Pleurotoma trilineata* Tryon, Man. vi. p. 368, not of Adams.

Fossil, Caloosahatchie beds. Recent, Jamaica; Samana Bay, Santo Domingo, in 16 fathoms.

The fossil form is the form described by Adams, which is a little smaller, as a rule, than the original type of Reeve from Gray's cabinet. If a varietal name be required, that of Adams might be used.

Drillia sedilia n. s.

Plate 2, figure 1.

Caloosahatchie beds, rare.

Shell small, stout, strongly sculptured; whorls about six, moderately rounded; suture appressed, inconspicuous; nucleus turbiniform, low, large for the size of the shell, smoothest on top, transversely strongly, uniformly plicate on the sides, with fine, spirally striate interspaces; later whorls with three or four (on the last whorl twelve) strong, even spiral cords with hardly wider interspaces, and five or six more closely crowded on the canal; the fasciole shows faint spiral threading of a finer kind on its surface, which is more distinct on the earlier whorls; transverse sculpture of (on the last whorl about twelve) rounded ribs, which do not quite reach the suture and are obsolete on the canal; the spirals cross these without nodulation; lines of growth faint; terminal varix stout; notch shallow, rounded; aperture rather wide and short, with a moderate callus near the notch and on the pillar and a slightly recurved wide and short canal. Max. lon. of shell 10.0; max. lat. 4.0 mm.

The most notable features of this little shell are the uniformity of its sculpture and its short and chunky form.

Drillia podagrina n. s.

Plate 2, figure 9.

Rare in the Caloosahatchie beds.

Shell elongated, acute, sharply sculptured, with a very small, smooth nucleus; spiral sculpture on the later whorls of (between the sutures three, on the last whorl eight or nine) rather fine, elevated, clean-cut even threads, not enlarged where they pass over the ribs; there are also a few close threads on the canal and one in front of the suture, beside a uniform, extremely fine spiral striation, only visible with a lens, which covers the whole shell; transverse sculpture of (on the last whorl ten) rounded ribs, strongest just in front of the fasciole, where they shoulder the whorl and extend forward to the canal; fasciole rather wide, well excavated and somewhat undulated by the ribs; terminal varix not very marked; notch deep, rather wide; aperture moderate, with a well-marked callus on the pillar; canal short, rather strongly recurved, which, with a sort of constriction behind the canal, gives the siphonal fasciole great prominence, while there is a shallow chink behind the callus of the pillar. Max. lon. of shell 14.0; max. lat. 5.3 mm.

This is an elegantly sculptured little species, not very close to any of the preceding.

Drillia piscator n. s.

Plate 2, figure 10.

Rare in the Caloosahatchie beds.

Shell small, slender, eight-whorled; nucleus at first rather large and smooth, later spirally grooved; later whorls with (on the last whorl seven) rather distinct, flattened, primary spiral threads, three between the sutures, beside two finer ones on the fasciole and several crowded, rounded threads on the canal; a very strong, rather angular spiral runs in front of the suture, which is otherwise hardly noticeable; transverse sculpture of (on the last whorl about seventeen) faint, narrow riblets, which extend from in front of the fasciole over the periphery and fade away or become duplicated on the base;

notch shallow, rounded; a moderate callus on the body; aperture short and narrow, with no differentiated canal. Max. lon. of shell 9.3; max. lat. 3.5 mm.

The principal characteristic of this species is the strong presutural thread. In the specimens collected the terminal varix was not quite completed, but when this occurs the outer lip is probably stouter than shown by the figure.

Drillia edilia n. s.

Plate 3, figure 9.

Caloosahatchie beds, one specimen.

Shell very small, short, with five or six slightly shouldered whorls; nucleus of the same general character as in *D. sedilia*, but transversely ribbed all over and more elevated; later whorls with rather faint, close-set, flattened spirals, which override the transverse sculpture but are very faint upon it; the interspaces appear like grooves and are more conspicuous than the spirals; the transverse sculpture of numerous (on the last whorl eighteen) narrow, rather feeble riblets, strongest near the fasciole, which is smooth, excavated and a little scalar; terminal varix swollen, notch wide and deep; aperture narrow, not differentiated from the short canal. Max. lon. of shell 4.0; max. lat. 1.6 mm.

Notwithstanding the small size and large nucleus of this little shell, it has evidently begun its varix, though the callus on the body is not yet complete. I cannot so far find any other to unite it with.

Drillia bigemma n. s.

Plate 2, figure 6.

Caloosahatchie beds, rare.

Shell small, stout,fusiform, six-whorled; nucleus rather large, at first smooth, then spirally grooved; succeeding whorls rather coarsely sculptured; spiral sculpture of rather sharp grooves, with wide interspaces, cutting the transverse sculpture; on the earlier whorls there is a stout cord next the suture, in front of which the fasciole is somewhat depressed, with three or four fine spirals on it; on the periphery is a deep groove, and next the succeeding suture the whorl is again depressed; on the base of the last whorl in front of the periphery are about six interspaces between grooves, of which the first, third and fourth are depressed below the others; all the others have their posterior edges higher than the anterior edges; beside these there are four or five flattish spirals on the canal; the transverse sculpture is exhibited chiefly in the form of nodes on the spirals. On the periphery, divided by a sharp groove, is a paired series of large, axially oblong nodes; on the basal spirals the nodes are small, squarish and twice as numerous in the same spiral distance; the presutural cord has a series of round nodules which sometimes are obsolete, but when present follow the peripheral nodes; terminal varix not prominent; notch wide and deep; callus moderate; outer lip arcuate in the middle; canal wide, short, straight. Max. lon. of shell 8.0; max. lat. 3.0 mm.

This species is rather peculiarly sculptured and I do not recall any recent species resembling it.

Drillia leucocyma Dall.

Drillia leucocyma Dall, Proc. U. S. Nat. Mus. vi. p. 328, pl. 10, fig. 8, 1883.

Drillia zebra var. Tryon, non Lamarck, Man. vi. p. 197, pl. 34, fig. 2, 1884.

Caloosahatchie beds. Recent, shores of the Gulf of Mexico from Florida to Yucatan, in 3 to 5 fathoms.

This species belongs to a large group which are without doubt related. As a well-marked combination of certain characters not directly intergrading with its neighbors, I prefer to retain it in specific rank.

Drillia albomaculata Orbigny.

Pleurotoma albomaculata Orb., Moll. Cuba, II. p. 176, pl. xxiv. figs. 16 to 18, 1842.

Pleurotoma albopustulata Smith, Ann. Mag. Nat. Hist. 1882, p. 211.

Drillia zebra var. Tryon, Man. vi. p. 197, pl. 14, fig. 11, 1884.

Caloosahatchie beds. Recent, Florida and the West Indies.

This is one of the forms related to but distinguishable from the preceding and found in similar situations.

Drillia (**lissotropis** var. ?) **perpolita** Dall.

Plate 2, figure 2.

Pleurotoma lissotropis Dall, Bull. Mus. Comp. Zool. ix. p. 58, Aug. 1881 ; Rep. Blake Gastr., p. 91, pl. xi. figs. 3, 4, 1889.

Pleurotoma hypsela Watson, Journ. Lin. Soc. xv. p. 433, Oct. 1881 ; Chall. Gastr., p. 341, pl. xxi. fig. 4, 1885.

Type, recent in the Gulf of Mexico and West Indies in 73 to 248 fathoms.

Variety *perpolita*. Fossil in the Caloosahatchie beds.

This shell differs from the recent *D. lissotropis* in the entire absence of the fine spiral striation which in nearly all specimens of *lissotropis* is visible between the ribs. It is uniformly stouter, the ribs are more widely separated and flexuous. The anal fasciole forms a moderate constriction which nearly cuts off the ends of the ribs where they abut on the suture behind them ; these ends have therefore somewhat the appearance of a row of nodules. In *D. lissotropis* the fasciole is hardly perceptible, the ribs appear continuous and less sharp-edged than in *perpolita*. I consider it probably specifically distinct from *D. lissotropis*, which is, however, its nearest relative. The max. lon. of *D. perpolita* is 9.75 ; max. lat. 3.0 mm.

Drillia (**lissotropis** var.) **scissurata** Dall.

This form is rather stout, like *D. perpolita*, but with more oblique and, on the last whorl especially, more crowded and narrower ribs ; the fasciole hardly constricts the whorl, which slopes from the suture forward so that its widest part is just behind the next suture, which it seems to overhang. It has not the fine, even interstitial spiral striation of *D. lissotropis*, but has sparse (on the upper whorls two or three) incised lines, more numerous on the base, where the interstices are slightly elevated and rounded. On the first three or four whorls, after the nucleus, the ribs are largest and subnodulous at the anterior border of the whorl, giving the tip a coronated look. It is almost exactly the size of *D. lissotropis*. Two immature specimens were obtained in the Caloosahatchie beds.

Drillia Simpsoni Dall.

Pleurotoma Simpsoni Dall, Proc. Dav. Acad. Sci. v. p. 54, 1887.

Drillia Simpsoni Dall, Rep. Blake Gastr., p. 91, 1889.

Caloosahatchie beds. Recent, North Carolina to Florida in moderate depths of water.

Drillia ebur Reeve.

Pleurotoma ebur Reeve, P. Z. S. 1845, p. 116; Conch. Icon., *Pleurotoma*, pl. xxx. fig. 275, Dec. 1845.

Clavus ebur Tryon, Man. vi. p. 188, pl. xiii. fig. 56, 1884.

Drillia ebur Dall, Rep. Blake. Gastr., p. 89, 1889.

Fossil, Caloosahatchie beds. Recent, in moderate depths, from North Carolina to Florida and in the northern Antilles.

Genus **MANGILIA** (Leach) Risso.

Many of the species cited being known only from their shells, the reference of them to one genus or another must be regarded as provisional. They have been assorted by the general habit of the shell, which is the only guide we have, and which is not without value when its recognition is deduced from sufficient study of recent forms. The present genus includes all *Pleurotomidæ* without opercula, following the arrangement of the distinguished French paleontologist, Dr. Paul Fischer. The subordinate divisions recognized for the purposes of this paper are:

Subgenus **Cythàra** Schumacher.
Subgenus **Daphnella** Hinds.
Subgenus **Glyphostoma** Gabb.
Subgenus **Mangilia** Risso; s. s.
Subgenus **Pleurotomella** Verrill.

I have enlarged on the characteristic features of these groups in my Report on the Mollusca of the Blake Expedition, recently published, to which readers are referred for more detailed information.

Subgenus **Cythara** Schumacher.

Cythara balteata Reeve.

Mangilia balteata Reeve, Conch. Icon., *Mangilia*, fig. 57, 1846.

Caloosahatchie beds. Recent from North Carolina to the West Indies at moderate depths.

Cythara psila Bush.

Mangilia psila Bush, Trans. Conn. Acad. vi. p. 455, pl. xlv. fig. 2, 1885.

Caloosahatchie beds. Recent off the coast of the Carolinas in 16 to 50 fathoms.

Cythara terminula n. s.

Plate 2, figure 5.

Caloosahatchie beds, rare.

Shell acute at both ends, seven-whorled; nucleus minute, smooth; later whorls transversely sculptured with nine narrow, rather sharp uniform ribs extending from suture to canal in a nearly straight line, and but little stronger on the periphery than elsewhere; there are also fine, sharp incremental lines, most marked in the spiral furrows; spiral sculpture of numerous rather uniform flattened bands separated by sharp, much narrower channels, and marked by a central impressed line less deep and wide than the channels, but giving to the bands the look of running in pairs; suture appressed and inconspicuous; whorls fuller near the suture in front than at the middle of the whorl, and rather depressed in front of the suture, though not marked by a fasciole there; last whorl much the largest; aperture long and narrow; notch inconspicuous, canal not differentiated; callus smooth on the pillar and smooth or slightly striated by the sculpture, inside the outer lip; varix stout and wide. Max. lon. of shell 16.0; of last whorl 12.5; max. lat. of shell 6.7 mm.

Subgenus **Daphnella** Hinds.

Daphnella cingulata n. s.

Plate 2, figure 3.

Rare in the Caloosahatchie beds and at Shell Creek, Florida.

Shell slender, eight or nine-whorled; nucleus small, smooth, three-whorled; subsequent whorls spirally sculptured with larger and smaller squarish elevated threads, which, on the last whorl, tend to be alternately strong and weak; the two series are remarkably uniform among themselves, except that on the periphery two or three of the primary threads will be a little more prominent than the rest, while on the fasciolar region there are five or six uniform large secondary threads, close-set, without any primaries; the transverse sculpture comprises on the earlier whorls eight or ten rounded riblets well defined near the nucleus, but becoming less distinct and finally obsolete on the later whorls; the last whorl and a half has no trace of them; whorls rounded, suture distinct, but not channelled or appressed; incremental lines distinct, slightly elevated, neatly reticulating the secondaries and beading the primaries; aperture elongate, rather narrow, not differentiable from the canal; outer lip smooth within, inner lip with but little callus; notch wide, not very deep; canal hardly indicated. Max. lon. of shell 15.5; max. lat. 6.5 mm.

This elegant species is nearest the recent *D. limnæiformis* Kiener, from which it differs in its stronger sculpture, proportionally longer spire, less reticulated early whorls ; fuller and more accentuated whorls, deeper notch and less arcuate columella.

Daphnella elata Dall.

Daphnella elata Dall, Rep. Blake Gastr., p. 105, 1889.

Caloosahatchie beds, rare. Recent on the coast of the Carolinas and southward in 15 to 22 fathoms.

Three specimens of this very elegant little species were obtained from the marls. It is possible that it should be referred to *Mangilia*, as restricted, but the shell is about midway between that group and *Daphnella.*

Daphnella modesta n. s.

Plate 2, figure 4.

Rare in the Caloosahatchie beds.

Shell with a small, smooth, tilted nucleus of about two whorls and about four and a half subsequent whorls; shape short-fusiform, the whorls well rounded, the last much the largest; spire not more than half as long as the shell ; spiral sculpture of numerous distinct, slightly elevated, subequal threads, with wider interspaces, in which near the aperture in the adult faint intercalary threads begin to appear; transverse sculpture of incremental lines, not very distinct, and (on the last whorl sixteen or seventeen) narrow, rounded, somewhat unequal wave-like ribs which begin at the suture, follow the curve of the lines of growth, cross the whorl and only fade away near the canal; they are about equally strong all the way ; the last rib is a little stronger than the others; fasciole not strongly marked, the ribs cross it and the spirals are a little finer and more close-set upon it; suture distinct, not channelled, undulated by the ribs; notch wide and shallow; aperture elongated, not wide, the canal not differentiated, the body with very little callus; outer lip simple; throat without liræ. Max. lon. of shell 6.5 ; max. lat. 3.0 mm.

This pretty little species has no very marked characters, yet on comparison with the recent forms it seems to agree with none of them. It is nearest *D. retifera* Dall, but has a different surface. It recalls *Mangilia biconica*, but its characters are essentially those of *Daphnella.*

Subgenus **Glyphostoma** Gabb.

Glyphostoma gratula Dall, var. **incilis** Watson.

Pleurotoma (*Drillia*) *incilis* Watson, Linn. Soc. Journ. xv. p. 425, Oct. 1881. Rep. Chall. Gastr., p. 304, pl. xxiv. fig. 5, 1885.

Pleurotoma (*Drillia*) *gratula* Dall, Bull. M. C. Zool. ix. p. 64, Aug. 1881.

Glyphostoma gratula Dall, Rep. Blake Gastr., p. 110, pl. xii. fig. 10, 1889 (var. *incile*).

Caloosahatchie beds, one adult specimen. Recent in the Gulf of Mexico and among the northern Antilles in 227 to 447 fathoms.

The fossil specimen is of but moderate size, but agrees sufficiently with the recent specimens to leave no reasonable doubt as to its identity.

Glyphostoma Watsoni n. s.

Plate 2, figure 7.

Caloosahatchie beds, not rare.

Shell small, seven or eight-whorled ; nucleus smooth, slightly tilted, the first whorl simple, the next with a peripheral keel ; transverse sculpture varying in strength, generally with (on the last whorl about twelve) riblets, most prominent on the periphery, absent from the anal fasciole and weak on the base ; surface finely shagreened ; spiral sculpture, on the anal fasciole of fine, close-set spiral threads ; in front of the fasciole these are replaced by coarser, less crowded threads, of which one or two on the periphery are more prominent and tend to angulate the whorls ; canal short, varix stout, wide ; aperture internally denticulate on the outer lip, with four or five teeth in front of the notch and on the inner lip about as many, or more, stout, rounded transverse liræ. Max. lon. of shell 7.5 ; max. lat. 3.7 mm.

This little species is in most respects a diminutive copy of the *G. gratula*, but differs also in the close, distinct spiral sculpture of the fasciole, which is proportionally wider than in *G. gratula* and more roof-like, or less depressed. The canal is also proportionately shorter and the peripheral keel, or keels, are sharper.

Mangilia quadrata Reeve.

Pleurotoma quadrata Reeve, Conch. Icon., *Pleurotoma*, pl. xxviii. fig. 253, 1845.

Pleurotoma diminuta C. B. Adams, Contr. Conch., p. 62, 1850.

Mangilia eritima Bush, Trans. Conn. Acad. vi. p. 456, 1885.

Clathmella quadrata Tryon, Man. vi. p. 278, pl. xviii. fig. 31, 1884.

Caloosahatchie beds. Recent, North Carolina to Yucatan and the West Indies in moderate depths.

Mangilia quadrata var. **eritima** Bush.

Caloosahatchie beds. Recent, North Carolina, etc.

Identified from typical specimens. Hardly to be even varietally distinguished from *M. quadrata* Reeve.

Mangilia monilifera Sowerby.

Columbella monilifera Sby., P. Z. S., p. 53, 1844. Tryon, Man. Conch. v. p. 149, pl. 53, fig. 100 (bad), 1883. Reeve, Conch. Icon., *Columbella*, pl. xx. fig. 117 (good), 1858.

Clathurella monilifera Tryon, Man. vi. p. 278, pl. 14, fig. 9, pl. 18, fig. 43, 1884.

Pleurotoma fuscolineata C. B. Adams, Proc. Bost. Soc. Nat. Hist. ii. p. 4, 1845; Contr. Conch., p. 54.

Pleurotoma scalpta Reeve, P. Z. S. 1846, p. 5, Tryon, Man. vi. p. 278, pl. 18, fig. 43, 1884.

Caloosahatchie beds. Recent, South Florida and the West Indies, in shallow water.

I suspect that Mr. Tryon had two species confounded in his mind. At all events, the figure he speaks of as bad is much more characteristic than the one he does not criticise.

Mangilia melanitica Dall, var. **oxia** Bush.

Mangilia melanitica Dall, var. *oxia* Bush, Trans. Conn. Acad. vi. p. 459, pl. xlv. fig. 3, 1885.

Caloosahatchie beds. Recent, North Carolina to Florida, in 10 to 25 fathoms.

The typical form is more closely sculptured than Miss Bush's variety, and is of a milky white with a black columella. Hers is more sparsely transversely sculptured, has a more smooth and glistening surface, sharper ribs, and is often of a reddish brown all over and not much darker on the pillar. It is rare in the marls.

Mangilia plicosa C. B. Adams.

Pleurotoma plicata C. B. Adams, Bost. Journ. Nat. Hist. iii. p. 318, pl. iii. fig. 6, 1840; not of Lamarck.

Pleurotoma plicosa C. B. Adams, Contr. to Conch., p. 54, 1850.

Pleurotoma plicatum Kurtz, Catalogue, p. 9, 1860.

Pleurotoma brunnea Perkins, Proc. Bost. Soc. Nat. His. xiii. p. 121, 1869.

Clathurella Jewettii Stearns, Proc. Acad. Nat. Sci. Phila. for 1873, p. 346; Dall, Hemphill's Shells, p. 329, 1883.

Caloosahatchie beds. Recent, New England to Florida, near low-water mark.

Prof. Adams' name having been, under the systems then prevailing, a synonym, it is proper to accept his substitution of another for it.

Mangilia stellata Stearns.

Mangilia stellata Stearns, Proc. Bost. Soc. Nat. Hist. xv. p. 22, 1872; Dall, Hemphill's Shells, p. 328, 1883.

Caloosahatchie beds. Recent, West Coast of Florida from Cedar Keys to Key West.

Mangilia rubella Kurtz & Stimpson.

Mangilia rubella K. & S., Proc. Bost. Soc. Nat. Hist. iv. p. 115, 1851.

Caloosahatchie beds. Recent, North Carolina to Florida.

The recent form is easily recognized by its acute spire and canal, and few angular whitish ribs, with darker interspaces.

Subgenus **Pleurotomella** Verrill.

Pleurotomella chariessa var. **pistillata** Dall.

Plate 3, figure 3.

Clathurella chariessa Watson (pars), Chall. Gastr., p. 352, pl. xx. fig. 6, 1881.

Pleurotomella Jeffreysii Verrill (pars), Trans. Conn. Acad. vi. p. 411, pl. xliv. fig. 3, 1885.

Caloosahatchie beds, rare. Recent in 300 to 1600 fathoms in the North Atlantic.

The sculpture of the single specimen obtained, though not quite mature, is identical with the typical *Pl. chariessa*. But that species has a white pillar in all the specimens I have seen, while the fossil exhibits beyond question remnants of a dark reddish or brownish coloration on the pillar. As the adult may show other differences when obtained, though certainly intimately related to *Pl. chariessa*, I separate the fossil varietally, under the above name. The recent shell is very variable and has many varieties.

Pleurotomella ? sp. indet.

Caloosahatchie beds, a fragment, different from any of those above characterized, but insufficient for description.

Pleurotomella ? sp. indet.

Caloosahatchie beds; a minute, single specimen somewhat damaged and insufficient for description, but distinct from any of those previously mentioned and from any of the recent species. It may be a *Mangilia* or *Daphnella*.

FAMILY CANCELLARIIDÆ.

Genus **CANCELLARIA** Lamarck.

Subgenus **Cancellaria** s. s.

Cancellaria Conradiana n. s.

Plate 3, figure 13.

This shell differs from the common and well-known *C. reticulata* Linne of the recent fauna of the Gulf of Mexico in the following particulars: It is much more slender: a specimen 38.0 mm. long has a maximum width of 19.0 mm. A specimen of *C. reticulata* 38.0 mm. long has a maximum width of 23.0 mm. In *C. Conradiana* the aperture is half the total length; in *C. reticulata* the aperture is five-eighths as long as the whole shell. The sculpture is essentially the same in both, and passes through the same range of variations. The suture is less marked in the fossil than in the recent shell. In both there is a slender elevated thread on the body, hardly visible at the aperture; there are also two much elevated, revolving plaits on the pillar and the anterior edge of the pillar is sharp and prominent. Except that on the body, these ridges have a tendency to become double-edged by the development of a secondary cord or ridge on their anterior faces. In the fossil, on the average, these folds are less thick and less double than in the recent shell, while the columella and its fasciole are narrower, weaker, and with a smaller umbilical chink.

About forty specimens of the recent shell have been compared with a good series of the fossil, and so far not a single specimen of the recent form has been found among the fossils, though there is some variation as to stoutness, especially among the young shells. The longest specimen of the fossil is 62.0 mm. in length, which exceeds in size the largest *C. reticulata* I have seen. This species is without doubt a near connection of the recent form.

Cancellaria reticulata Linné.

Cancellaria reticulata Linné, Lam. An. sans Vert. vii. p. 112, 1822.

This well-known shell was found in the Post-Pliocene of South Carolina (Post.-Pleioc. Foss., pl. x. fig. 6) by Holmes, and in North Carolina by Emmons (Geol. Rep., p. 255, fig. 119, 1858), who gives no locality, but enumerates it among his Miocene fossils, where it certainly does not seem at home. A Miocene analogue exists in the *C. lævescens* Guppy from Jamaica (Quart. Journ. Geol. Soc. xxii. pl. xvii. fig. 12, 1866) and the preceding species has also an analogue in the Jamaica Miocene (*opus cit.*, pl. xvii. fig. 11), which apparently differs from *C. Conradiana* chiefly in the situation and form of the columellar plaits. This is the *Cancellaria Barretti* Guppy.

The West Indian recent *C. rugosa* Lam., *C. similis* Sow., and similar species have a precursor in the *C. Moorei* Guppy (*opus cit.*, pl. xvii. fig. 7), but nothing of this sort appears among our Floridian fossils, so far. The early Cancellarias of the United States appear to belong rather to the *Trigonostoma* group.

Thus we have the *Trigonostoma carolinensis* Emmons, from the Cape Fear and West Florida Miocene, represented in the recent fauna by *T. tenera* Phil., which also appears in the Caloosahatchie beds. There is another species, *C. perspectiva* Conrad, from the Miocene of Duplin County, North Carolina, which belongs to the same group, but is differently ornamented.

Of the small Trigonostomas there are a dozen species referred to the Eocene, of which several will perhaps fall into synonymy at a later date. Several are closely related to certain species of the recent fauna, such as *T. Smithii* Dall and *T. Agassizii* Dall. When full and continuous series have been obtained from our various Tertiary beds, the genealogy of many of the recent species of our fauna will be readable almost at a glance. The intimations, which even our present imperfect knowledge affords, are extremely interesting.

Cancellaria venusta T. & H.

Plate 3, figure 12.

Cancellaria venusta Tuomey & Holmes, Pleiocene Foss of S. Carolina, p. 144, pl. 28, fig. 18, 1856. Not of Holmes, Post-Pleiocene Foss., p. 64, pl. x. fig. 7, 1860.

The shell figured by Holmes is, from his type, a *Tritonidea*, probably *T. cancellaria* Conrad, and obviously different from that figured in the earlier work. The present species is well characterized, and no recent representative of it is known in the present fauna.

Subgenus **Trigonostoma** Blainville.

Trigonostoma tenera Philippi.

Plate 10, figure 8.

Cancellaria tenera Philippi, Zeitschr. für Mal. V., p. 24, 1848.

Cancellaria Stimpsoni Calkins, Proc. Dav. Acad. Sci. II., p. 250, pl. viii. figs. 4, 5, 1878.

This species, which in the recent state inhabits the Gulf of Mexico, and is represented on the west coast of Central America by *C. bullata* and *C.*

tuberculosa Sowerby, occurs rarely in the Caloosahatchie beds, and, in the Miocene of North Carolina, is represented by *T. carolinensis* Emmons.

Trigonostoma subthomasiæ n. s.

Plate 11, figure 3.

Shell in general much like *C. Thomasiæ* Crosse (*C. scalarina* Sowerby, Reeve, non Lamarck), but with a proportionally shorter spire, stronger spiral striation and of smaller size. Whorls six, scalar, crossed by about (on the last whorl) 14 strong rather sharp ribs, spinose at the carina and lamellar behind it; spiral sculpture of numerous rather distant, little elevated small threads with wider, sometimes striate interspaces; aperture oblique, about half the length of the shell, strongly lirate, triangular, with three well-marked folds on the pillar; umbilicus rather narrow; ribs occasionally varicose. Max. lon. of shell 20.0; of aperture 10.0; max. lat. of shell 12.0 mm.

Tampa silex-beds, at Ballast Point, Dall, one specimen.

This shell, though smaller than either, seems intermediate in other characters between the Indo-Pacific recent *C.* (*T.*) *crenifera* Sby. and *C.* (*T.*) *Thomasiæ* Crosse. Though the specimen is seriously injured, it furnishes the characters necessary for description. Its nearest fossil relative in our Tertiary is perhaps *C.* (*T.*) *gemmata* Conrad, from Claiborne, Alabama, which is smaller and narrower, and wants the spiral threading.

None of the English Crag, Paris or Vienna basin fossil species are particularly similar to the present species. The process of silicification may have more or less modified the external characters, and I can only describe them with all reserves.

FAMILY OLIVIDÆ.

Genus **OLIVA** Bruguière.

Oliva litterata Lamarck.

Oliva litterata Lam., An. s. Vert. vii. p. 425, 1822.
Oliva literata Lam., Emmons, Rep. N. Car. Geol. Survey, pp. 259, 264, fig. 130, 1858.
Strephona literata Tuomey & Holmes, Pleioc. Foss. S. C., p. 140, pl. xxviii. fig. 13, 1858.
? *Strephona literata* Holmes, Post-Pleioc. Foss. S. C., p. 75, pl. xi. fig. 7, 1860.
Dactylus carqlinensis Conrad, Proc. Acad. Nat. Sci. Phila. xiv. p. 563, 1863.
Oliva cylindrica Sowerby, Quart. Journ. Geol. vi. p. 45, 1849, *ex parte* (Miocene of Santo Domingo).
Oliva olivacea Marrat, as of Meuschen.

Miocene of Santo Domingo, West Florida and North Carolina; Pliocene of the Carolinas and Caloosahatchie beds of Florida; Post-Pliocene of South Carolina (Simmons' Bluff, etc.) and Florida. Recent, North Carolina and West Indies.

This species is only to be discriminated from *O. reticularis* by slight differences of color and its slightly more cylindrical form. It is rare in the Caloosahatchie beds, and I have seen no specimens which could be confidently referred to *O. reticularis* from these beds. I have seen no genuine specimens of *O. reticularis* from the coast of the United States, or north of the Florida Keys and the Bahamas, in a recent state. Both species occur in the Miocene of Bowden, Jamaica, and the Haitian Miocene. Both are also found there in the recent state. From the Costa Rica Pliocene Gabb reports only the *O. reticularis*, but it is quite possible that the " *O. ispidula* " which he cites from that formation is merely a variety of *O. litterata*. Sowerby's *O. cylindrica* certainly contains both species, but was diagnosed on the *O. litterata*. As Meuschen was not a binomial writer, his name should not take precedence of the one given by Lamarck. After careful comparison I have not been able to find any distinctive character by which Conrad's *O. carolinensis* might be distinguished from the recent *O. litterata*. The differences which one may observe in a few individuals are shown by a large series not to be characteristic of anything but stages of growth, absence of color and individual mutation.

Genus **Olivella** Swainson.

Olivella mutica Say.

Oliva sp. Emmons, N. Car. Geol. Rep., p. 259, fig. 131 a, 1858.
Oliva mutica Holmes, Post-Pleioc. Foss. S. Car., p. 76, pl. xii. fig. 8, 1860.
Oliva muticoides Gabb, Geol. Santo Domingo, p. 215, 1873.
Oliva duplicata Conrad, Proc. Acad. Nat. Sci. Phila. I. p. 309, 1843.

Miocene of Santo Domingo, West Florida and North Carolina; Caloosahatchie beds, Florida; Post-Pliocene of South Carolina and Florida. Recent from the coast of the Carolinas southward to the West Indies.

Gabb's variety *muticoides* differs chiefly by the state of its development from the typical form of recent seas in some of its multitudinous varieties. It has never been figured. The Caloosahatchie specimens resemble the recent form precisely, as do authentic specimens of Conrad's *duplicata*. Both pass through a similar series of mutations between individuals.

Olivella nitidula Dillwyn.

Olivella nitidula Dillwyn, Tryon, Man. v. p. 64, 1883.

Caloosahatchie beds. Recent in Florida and the West Indies.

This form is referred to *O. mutica* as a variety by Tryon, and it may well be a large race of the preceding species. It is, however, not difficult to separate, and I have preferred to keep it so for present convenience.

From the Miocene of Bowden, Jamaica, I have received *O. jaspidea* Gmelin and its variety *rotunda* Dall, but I have not identified any specimens from the Caloosahatchie beds, though the species is found recent on the Florida coast.

Olivella lata n. s.

Plate 4, figure 8 b.

Shell small, broad, moderately stout, with a rather low spire and about five whorls; surface smooth, suture narrow, deeply channelled and deeply notched at the aperture; spire with little enamel and a rather large globular nucleus of one whorl; outer lip arcuate, simple, sharp; inner lip with a moderate callus, hardly lirate; pillar straight, slightly twisted, with a groove behind it; canal short, wide, shallow; siphonal fasciole distinct, bordered behind by a faint sulcus, behind which again is a still fainter indication of a depressed line. Max. lon. of shell 9.25; max. lat. 5.25 mm.

Ballast Point silex-beds; Dall, Shepard.

It is not unlikely that, when fully adult, this shell has the pillar lip lirate; but even if it is immature it cannot be united with any of our Tertiary species. It is perhaps nearest some of the recent forms like *O. strigata* Reeve and *O. fuscocincta* Dall from the West Indies, none of which, however, are as broad and thin as *O. lata.*

Genus **ANCILLARIA** Lamarck.

Ancillaria Shepardi n. s.

Plate 4, figure 4.

Shell slender, acutely pointed, with its surface on the spire glazed with a coating of enamel, but indicating about five whorls; aperture less than half the length of the shell, callous at the posterior commissure and on the body; outer lip arched, simple, thin, perhaps with a slight projection in the adult, near the canal, between the two principal sulci of the whorl; canal wide and deep; pillar concave and twisted, scored with numerous fine shallow, spiral grooves, and with a pronounced sulcus behind it; the anterior end of the pillar is obliquely truncate, shorter than the aperture and with its anterior edge excavated so as to make a shallow gutter, behind which the edge of the whorl projects in a rounded point before falling to the siphonal notch. In this manner, when looked at directly from in front, the shell seems to have two canals, one small and shallow, curving with the pillar, the other larger and deeper, cut out of the wall of the whorl. On the base behind the pillar is the usual sulcus, followed by the siphonal fasciole bordered behind by a sharp impressed line; then follows a band about as wide as the siphonal fasciole, but of which the anterior half is convex and the posterior half impressed; this is bordered by a band or fasciole between two sharply and deeply incised lines; this fasciole is transversely striate with backwardly somewhat concave lines and corresponds to the tooth or projection of the outer lip, if one existed, which is not certain. On the last whorl in front of the suture is another impressed spiral line or groove, not very distinct on the fossils, but which seems to have formed the anterior border of the enamel on the spire; the callus on the inner lip does not thin out over the body, but is bounded by a straight line extending from the columellar sulcus to the spiral line just described; the posterior commissure of the aperture is more or less filled with callus. Max. lon. of shell 34.75; of aperture 17.0; max. lat. of shell 14.5 mm.

Silex-beds of Ballast Point and the shores of Hillsboro' Bay, Tampa Bay, Florida; Shepard, Newman and Dall.

This fine shell differs from any of the previously described Tertiary species of our Atlantic region. It does not resemble the *A. glabrata*, the only form now known from the Floridian region in the recent state, but is nearest the *A. Tankervillei* Swainson, from the Antilles. This is a much broader and larger species. The *A. similis* Sowerby from North Australia is more like it, but the proportions are different. It is named in honor of Mr. James Shepard, of New Britain, Conn., to whom we are indebted for specimens.

FAMILY MARGINELLIDÆ.

Genus **MARGINELLA** Lamarck.

Marginella ballista n. s.

Plate 4, figure 6.

Shell large, strong, rounded, subpyriform; whorls about four; spire short, nearly enclosed by the last whorl; sides convex, compressed about the middle near the adult varix; outer lip thick, differentiated by a sulcus behind it, arcuate in the direction of the whorl and also toward the body-lip, aperture rather wide, especially in front; body-wall with a callus which extends over the spire from the posterior commissure; anteriorly with four rather oblique plaits; outer lip smooth within. Max. lon. of shell 18.0; lat. 11.7; lon. of aperture 16.2 mm.

Tampa silex-beds at Ballast Point.

This has a peculiarly rounded form and thickened outer lip, which last has no denticulations within.

Marginella (ballista var. ?) **tampæ** Dall.

This form differs from the last by having straighter sides and therefore more conical form, being wider at the shoulder and having a more elevated and acute spire; the two posterior plaits are stronger, less oblique and more widely separated from the anterior pair and from each other. Lon. of shell 19.0; of aperture 16.5; max. lat. of shell 12.5 mm.

Tampa silex-beds.

This form, which more specimens might show to have specific value, resembles Nelson's figure of *M. incrassata* from the Tertiary of Peru (Trans. Conn. Acad. II., plate vi. figs. 5, 6), but has a higher spire, one more plait, does not flare so much at the anterior end, which is also more attenuated, while the outer lip is decidedly thicker.

Marginella precursor n. s.

Plate 5, figure 4.

Shell stout, solid, five-whorled; original color dark brown or amber, with numerous large, sharply defined, irregular-shaped, close-set spots of a much lighter color, probably white, all over the surface; form attenuated in front; sides somewhat convex, with little or no central compression behind the varix which finally distinctly marginates the end of the last whorl; spire low, invaded by the body-callus, but slightly surpassing the outer lip in height; inner lip with a polished callosity particularly marked and elevated behind the middle of the aperture; plaits five, the anterior the larger, the fifth feeble but always present in the adult; outer lip thick, nearly straight in the middle, internally denticulate, prolonged behind and curved on to the preceding whorl; aperture subequal, not very wide. Lon. of average specimen 16.0; of aperture 15.2; lat. 10.5 mm.

Caloosahatchie beds.

This species weathers so as to present longitudinal ribbing, but this is adventitious. It had originally the coloring of some varieties of *M. apicina*, but the white spots were larger and more sharply defined. *M. nivosa* shows similar but smaller spots on a pale ground.

This species recalls *M. cassis* Dall from the West Indies, but has a smaller spire, its shell is larger, heavier, fuller and rounder behind, is of a different color and has one more plait.

Than the spotted variety of *M. apicina* it is larger, more triangular, with a lower spire, more angular behind, and the posterior turn of the outer lip relatively more posterior. From *M. limatula* it differs in color, shape, and height of spire. The figure was made from a specimen not showing the spots, which in disposition resemble those of figure 2 on the same plate.

Marginella virginiana Conrad.

Prunum virginiana (sic) Conrad, Am. Journ. Conch. iv. p. 67, pl. 5, fig. 4, 1868.

Miocene, James River, Virginia. Pliocene, Caloosahatchie beds. Recent, off the east coast of North America, from North Carolina to Yucatan, in 14 to 25 fathoms, sand.

This species is well represented in the marl from the Caloosahatchie and in the inshore dredgings of the U. S. Fish Commission off the Carolinas. At first the recent specimens were not recognized and were taken for a diminutive race of *M. amabilis* Redfield, under which name some of them have been sent out. The colors of the recent shell in its finest condition are pale flesh-color, with or without a darker band in front of the suture on the last whorl, and another near the anterior end following the direction of the posterior plait around the shell. In front of the last dark band, when present, and on the spire and outer lip, the shell is whiter, and on the body a close inspection shows that the whole flesh-colored surface is closely dotted with small flecks of pale yellow or brown. The interior of the aperture is pink. From this, which represents the most perfect condition, the fresh shells vary to yellowish and white. There are four oblique plaits, of which the anterior pair are stronger and more contiguous. The fossils sometimes retain traces of the body-color. Conrad's figure is shorter and stouter than the average form of the species, though such specimens occur.

Marginella (apicina Menke var.?) **pardalis** Dall.

Plate 5, figure 2.

? *Marginella apicina* Menke, Syn. Meth. Moll., p. 87, 1828, var.

Caloosahatchie beds.

These shells, which may possibly be referred to *M. apicina*, are uniformly smaller than the Floridian recent *M. apicina*, and in size and form resemble the more southern, unspotted variety which has been named *virginea*. They were originally spotted and still sometimes retain traces of the color, as in the one figured. Max. lon. of shell 10.0; lat. 8.0. mm.

Marginella floridana n. s.

Plate 5, figure 6.

Rare in the Caloosahatchie beds.

Shell small, stout, having nearly the form of *Persicula*, but the spire, though blunt, is not involute; whorls about four, inflated; sides moderately convex; aperture narrow, nearly straight; outer lip not very thick, not marginated externally, internally finely lirate; inner lip with a well-marked callus behind, in front four to six plaits, the anterior plait much the strongest, the others becoming fainter in their posterior order; siphonal fasciole distinct. Max. lon. of shell 5.0; max. lat. 3.3 mm.

This stout little shell, like *M. semen*, bridges the gap between *Persicula* and *Marginella* proper. It retains no color-markings, but its general form recalls that of the recent Floridian *Persicula catenata*, which has very pale markings which would easily be lost in fossilizing.

Marginella Lavalleana Orbigny.

? *Marginella minuta* Pfeiffer, Arch. f. Naturg. I. p. 259, 1840.

Marginella Lavalleana Orbigny, Moll. de Cuba, ii. p. 101, pl. xx. figs. 36–38, 1842.

Caloosahatchie beds, not common. Recent, on the Florida coast and among the Antilles.

There are two small species which occupy the same area, which I have elsewhere separated under the above name and that of *M. minima* Guilding. The present species agrees exactly with the recent shells.

Marginella limatula Conrad.

Marginella limatula Conrad, Journ. Acad. Nat. Sci. Phila. vii. p. 140, 1834. Foss. Med. Tert. U. S., p. 86, pl. 49, fig. 9 (error for fig. 11, fide Conr. in lit.), 1845.

Porcellana limatula Tuomey & Holmes, Pleioc. Foss. S. C., p. 130, pl. 27, figs. 10, 11, 1857.

Marginella roscida Redfield, Proc. Acad. Nat. Sci. Phila. xii. p. 174, 1860.

Prunum limatula (sic) Conrad, Am. Journ. Conch. iv. p. 67, pl. 6, fig. 5, 1868.

Tampa silex-beds. Miocene of Florida, Virginia and the Carolinas; Pliocene of Shell Creek, of Caloosahatchie beds and of South Carolina. Recent off the Carolina coast, abundantly, in 25 to 100 fathoms (living) sand and gravel.

All Conrad's figures of this species are too angular and produced at the shoulder where it reaches the terminal varix or outer lip. The recent shells vary considerably in size and height of spire, but the latter is usually rather elevated, and the shell anteriorly narrowed, while there is a peculiar aspect of the surface, something between rude and polished, which is as marked in the fossil as in the recent shells, and I have seen nothing like it in any other species.

It is distinctively a Northern species, and is not found in the present waters of Florida, as far as yet known. But there are several specimens from the silex-beds which do not seem to differ from specimens from Virginia and North Carolina of the same age, and one specimen was obtained from the Miocene at White Beach near Osprey. The Caloosahatchie specimens show markings like *M. nivosa* Hinds, which are very rare in the recent shells.

Marginella rostrata Redfield.

Marginella rostrata Redfield, Cat. Marg. Am. Journ. Conch. vi. p. 246 (note) ; Sowerby, Thesaurus, Marg., plate 76, figures 106, 107 (*oblonga* Sby. non Swainson).

Caloosahatchie beds, not common. Recent in the Gulf of Mexico in 84 fathoms.

These shells are mostly a little larger and heavier than the recent ones, though some specimens agree well with them.

Marginella Willcoxiana n. s.

Plate 5, figure 7.

Shell long, subcylindrical, narrow, with the apex covered with callus, though not entirely immersed in the last whorl ; a very obscure ridge encircles the shell at about the posterior third ; terminal varix broad, straight, externally marginated ; except at the extreme ends the inner edge of the outer lip is minutely denticulate; aperture narrow, as long as the shell, nearly straight, except for the sharp curve at the posterior commissure ; inner lip very callous behind, the callus extending on and over the spire; anterior part with four subequal strong plaits, the posterior plait less oblique than the others ; surface of shell very polished, with no trace of color. Max. lon. of shell 16.6 ; max. lat. 7.4 mm.

Caloosahatchie beds of the Caloosahatchie and at Shell Creek, Florida, Mr. Willcox.

This species is remarkably slender, narrow and cylindrical, and approaches very near to *Persicula* in form.

Marginella prunum Gmelin.

Voluta prunum Gmel., Syst. Nat., p. 3446, 1788 (ex parte) ; Dillwyn, Descr. Cat., p. 530, 1817.

Marginella cærulescens Lam., An. s. Vert. vii. p. 356, 1822.

Marginella prunum Reeve, Conch. Icon., Marg., pl. xi. fig. 45, a b, 1865. Redfield, Cat. Marg., p. 251, No. 153.

Caloosahatchie beds, rare. Recent on the Southern Antilles and northern shores of South America.

A single, not mature specimen of a shell which is referable to this species or to *M. pulchra* Gray was collected by me from the Caloosahatchie marls.

Marginella aurora n. s.

Plate 6, figure 4 a.

Miocene beds of the Chipola River, N. W. Florida, a stratum probably somewhat later than the silex-beds of Tampa.

Shell large, strong, with a short but sharp spire, and about five whorls; suture obscure; outer lip thick, strong, a channel behind it externally, inner edge finely irregularly denticulate; aperture narrow, posterior commissure extended to the third whorl from the nucleus, wider anteriorly; pillar with four subequal plaits, the anterior pair contiguous; body moderately callous; shell showing traces of a rich orange color, perhaps originally red, uniformly diffused. Max. lon. of shell 26.0; lat. 14.5 mm.

The form is that of *prunum*, with a higher spire, different lip and a posterior commissure like that of *M. carnea.*

Marginella denticulata Conrad.

Plate 5, figure 8.

Marginella denticulata Conrad, Journ. Acad. Nat. Sci. vi. p. 225, plate ix. fig. 21, 1830 (not of Tate, 1878). Miocene, Md.

Marginella eburneola Conrad, Journ. Acad. Nat. Sci. vii. p. 141, 1834. Mioc. Va.

Marginella denticulata Conrad, Foss. Med. Tert. Form. U. S., p. 86, pl. 49, fig. 10 (1845).

Marginella eburneola Conrad, Foss. Med. Tert. Form. U. S., p. 86 (not pl. 49, fig. 11, which is *M. limatula* Conr.), 1845 (not 1838).

Porcellana (*Glabella*) *denticulata* Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 564, 1862.

Porcellana (*Glabella*) *eburneola* Proc. Acad. Nat. Sci. Phila. 1862, p. 564, 1862.

Prunum eburneola Conrad, Am. Jour. Conch. IV. p. 67, pl. 5, fig. 1, 1868.

Marginella elevata Emmons, Rep. N. C. Geol. Sur., p. 262, fig. 138, 1858.

Marginella (*Glabella*) *opalina* Stearns, Proc. Boston Soc. Nat. Hist. xv. p. 21, 1872; recent, W. Florida.

Range, from the Miocene of Maryland and Virginia to the Pliocene (Caloosahatchie beds) and living on the coast of the United States from Cape Hatteras to Florida and in the Antilles to Barbados.

Perhaps no instance is more glaring of the singular carelessness by which the late Mr. Conrad marred his, in some respects, valuable paleontological work, than the history of this species. Described by him in 1830, with an unrecognizable figure, four years later he repeats the same diagnosis almost verbatim, and gives a new name with it, but no figure. In the Fossils of the Medial Tertiary of the United States, we have a publication begun in 1838, but of which (according to Mr. Conrad himself in correspondence with the late F. B. Meek) page 65 only appeared about 1844 or 1845. The latter pages and plates of this publication do not wholly correspond, some figures were distributed without text, and I believe for some of the text there are no figures. However, on plate 49, *M. denticulata* is represented by figure 10, though Mr. Conrad afterward believed it to be intended for his *eburneola*, an uncertainty not remarkable when we understand that the two names refer to the same species. On the same plate Fig. 9 was referred by the text to his *M. limatula* but erroneously. That species, according to Mr. Conrad, is represented by figure 11. Figure 9 represents the shell which (in Am. Journ. Conch. 1868, p. 66, pl. 5, fig. 3) Mr. Conrad named *Microspira oviformis* and again, in 1870, described the same specimen as new (with a reference to the same figure) under the name of *Persicula ovula!* On the same plate figure 12 represents *M. americana* Conrad (MS), of which no description appeared, only the name being printed (cf. Redfield's Catalogue of *Marginella* in 1871, p. 261). It has no characters which should separate it from *M. columba* Lea.

The recent shell was named in ignorance of the fossil, which indeed had never been properly figured so as to render its characters unmistakable.

The Caloosahatchie specimens are well developed. Some of them agree exactly with recent shells from the coast of North Carolina. Some are marked by a tendency to angulation at the periphery, though this is confined to certain individuals. Emmons' figure, though coarse, is the best yet published. The shells, whether recent or fossil, differ somewhat in size, and especially in stoutness; the living ones vary from pure white, and white banded spirally with yellow, to rich amber color all over, as does the next species. The name *opalina* might be retained in a varietal sense for the amber variety. This has been distributed by Col. E. Jewett and perhaps other collectors under the unpublished name of *M. mellifiua* Redfield.

The particular characteristics of *M. denticulata*, apart from its form, are the strong, even plaits, of which when adult the posterior is strongest; and the outer lip denticulated only in the middle part and rounding anteriorly into the edge of the columella without perceptible demarcation.

Marginella aureocincta Stearns.

Marginella (*Glabella*) *aureocincta* Stearns, Proc. Boston Soc. Nat. Hist. xv. p. 22, 1872.
Marginella virginiana Verrill, Trans. Conn. Acad. Sci. vi. p. 420, 1885. Not of Conrad.
Marginella Smithii Verrill, *op. cit.* p. 452, 1885. Bush, *op. cit.* p. 462, 1885.

Range, fossil in the Caloosahatchie beds, and living from Virginia to Florida.

This species, though more slender and fusiform, is much like a small edition of *M. denticulata*. In the recent shells the color varies from pure white to amber or white banded with amber. Stearns's type was of the latter variety. It is quite likely that *M. exilis* H. C. Lea (1843, not of Gmelin; *M. subexilis* Orbigny) from the Tertiary of Virginia may be the same thing as *aureocincta*, but

Lea's figure represents an immature and unrecognizable shell which may be the young of a species like *M. avena*, and consequently I have thought it better not to unite them. I have named the pure white form, variety *immaculata*, but it differs from the type only in color.

Marginella bella Conrad.

Plate 4, figures 8 d, 8 e, and 9 a.

Prunum bella (*sic*) Conrad, Am. Journn. Conch. iv. p. 67, plate 6, fig. 4, 1868; Proc. Acad. Nat. Sci. 1862, p. 564 (name only).

Virginia Miocene. Tampa silex-beds and orbitolite bed; Caloosahatchie beds. Recent, off the coast of North Carolina, living in 14 to 50 fathoms sand.

Among the original specimens of Conrad two species were represented, one of which he had already named *M. succinea*, and the present shell, which will retain the later name. Among the pseudomorphs in silex from Ballast Point, Tampa Bay, several varieties were represented. The most normal form is that indicated by figure 9 a (Plate 4). Max. lon. 8.0; lat. 4.5 mm. Specimens from the Caloosahatchie, and the recent shells are often more strongly shouldered than this. Among the Floridian specimens I find several which have a sort of ridge at the shoulder, which I take to be abnormal. The absolute size of the adult varies greatly, for the total length may be only five or six, or as much as nine or ten millimeters, though the proportions are tolerably constant. Figure 8 e represents a thinner, more oval form with a straighter outer lip (lon. 6.5; lat. 3.6 mm.), which may take the name of *bellula*. More material may show it to be a distinct species. Variety *inepta* Dall (Fig. 8 d) is smaller (5.5 lon. by 3.0 mm. lat.), with a relatively higher spire, more evenly tapered shell, and the outer lip less convex in the middle on the inside.

The recent shell is yellowish or pinkish white with axially directed fine opaque streaks hardly visible except on close scrutiny. They vary in size even more than the fossil ones.

M. bella was the type of Conrad's undefined group *Porcellanella*, which he afterward abandoned.

Marginella faunula n. s.

Plate 4, figure 9 b.

Shell thin, ovate, with a rather pointed spire of some four or five whorls covered with a thin glaze of callus; plaits four, subequal, thin, oblique, outer lip little thickened, externally marginated, arcuate in the direction of its growth, nearly straight in an axial direction; callus on the body very thin. Max. lon. 8.0; lat. 4.5 mm.

Tampa silex-beds, rare.

This shell recalls *M.* var. *bellula* in some of its features, while others remind one of *M. fauna* Sby. The habit of the shell is like the latter, while the form is more like the former.

Marginella elegantula n. s.

Plate 4, figure 7.

Shell of the group of *M. hæmatita* Kiener, from which species it differs by being proportionately stouter, rounder and less fusiform, with a shorter spire and wider aperture. Both have four well-marked plaits, which in *M. hæmatita* are grooved when adult. Both are externally smooth and have the outer lip marginated externally and denticulate internally, but in *hæmatita* the denticulations extend the whole length, while in the present species they are very faint and confined to the middle part of the inside of the outer lip. Max. lon. of shell 11.0; lat. 6.5 mm.

Tampa silex-beds, rare.

This species may be regarded as in the ancestral line of such forms as *M. margarita* and *M. hæmatita* Kiener, but I have not found any connecting Pliocene link, as yet.

Marginella Newmani n. s.

Plate 4, figure 8.

Shell small, stout, biconic, four-whorled, smooth, the spire glazed with callus; aperture short, wide, the outer lip with about six coarse denticles on the inner side, smooth near the posterior commissure, marginated externally; inner lip with a wash of callus, with four subequal, not prominent, rather oblique plaits. Max. lon. 5.5; lat. 3.7 mm.

Tampa silex-beds, rare; Mr. L. G. Newman.

This species belongs to the same group as the last; were it ribbed it would fall in nicely with such species as *M. striata* Sby. and *M. plicata* Lea. Its small size, breadth, and other features well shown by the figure sufficiently distinguish it.

Marginella pallida Donovan.

Bulla pallida Don., British Shells, pl. 66, fig. 527, 1800 (syn. excl.).

Marginella pallida Redfield, Cat. Marg., pl. 247, No. 138.

Caloosahatchie beds, rare. Recent Florida, Bermuda, Bahamas, Antilles.

The Caloosahatchie specimens are small but unmistakable.

Marginella avena var. avenacea Deshayes.

Marginella avenacea Deshayes, in Lam. An. s. Vert., 2me. éd. x. p. 455, 1844.

Caloosahatchie beds. Recent Florida and the Antillean region.

This is simply a dwarf *M. avena* Val. and, except in size, agrees with that species in form, while in size it agrees with specimens to which the varietal name has been applied.

Marginella styria Dall.

Plate 5, figure 1.

Marginella styria Dall, Rep. Blake Gastr. Bull. Mus. Comp. Zool. xxviii. p. 13, 1889.

Caloosahatchie beds. Recent off the coast of Georgia, in 400 fathoms, and living off Sombrero Island, West Indies, in 54 fathoms.

A fragment almost certainly of this species was found in the Caloosahatchie marl.

Marginella semen Lea.

Marginella semen Lea, Contr. Geol., p. 178, pl. 6, fig. 190, 1833.

Marginella larvata jun. Conrad, Foss. Tert. U. S., p. 45 (in error).

Marginella ovata Emmons, Rep. N. C. Geol. Sur., p. 261, fig. 136 (not of Lea).

Marginella sp. ? Conrad, Am. Journ. Conch. vi. plate 3, fig. (13?), 1870; figure in upper left-hand corner not numbered.

Range, Claiborne Sands Eocene, Miocene of North Carolina.

The *Marginella semen* of Lea was by Conrad referred to the young of *M. larvata* Conrad (*M. ovata* Lea.), but typical specimens now before me show this to have been an error. *M. semen* is a species which stands on the line dividing *Persicula* and *Marginella*. As Conrad observed in 1870, the subdivisions of the *Marginellidæ* in use for recent species are not applicable to the fossils, which illustrate every degree of intergradation. *M. semen* shows the tip of its spire, which is uncovered at all ages. It would therefore belong to the section *Cryptospira* H. and A. Adams. In *M. larvata* it is covered in the adult as it is in the *M. gravida*, which seems to be the descendant of *M. semen*.

An interesting feature of *M. semen* is that some specimens retain the color-marks, which are dark, narrow spiral bands, seven in the adult. I do not find this anywhere referred to.

In later beds we find the following species also banded with rows of square spots corresponding to the continuous bands in *M. semen*. In the Caloosahatchie form the size is greater and the spire hidden under a vortex of shelly matter, while the number of rows of dots is greater than that of the bands in *M. semen*. In the recent fauna we find in the Antillean species most nearly allied to *M. semen* and *M. gravida* that the size has increased still more, the number of spiral color series is still greater, and the spire is more deeply hidden. The present Floridian *Persicula* (*P. catenata*) is not as nearly related to these fossil species as are *P. chrysomelina*, *P. obesa* Redfield, and *P. interrupta* Lamarck. There is no reference in Conrad's text to his figure of 1870, above cited. It may have been intended for the following species, which it resembles.

Marginella gravida n. s.

Plate 5, figure 3.

Shell stout, short, rounded, with the aperture as long as the shell; color usually whitish, but when wet sometimes showing traces of eight or nine spiral series of squarish spots; aperture narrow, arcuate, as long as the shell; outer lip internally crenulated with about a dozen liræ; inner with two rather strong oblique plaits in front, the anterior plait being at the twisted edge of the pillar, and four or five smaller plaits or ridges, not oblique and growing fainter posteriorly; body-callus moderate, its posterior extension forming a sort of vortex over the spire, as expressed by the incremental lines. Max. lon. of shell 8.3; max. lat. 5.7 mm.

Miocene of Virginia and Pliocene of the Caloosahatchie beds, not rare.

This form is discussed under the head of the preceding. It is erroneously labeled *M. ovula* Conrad, in the collection of the Philadelphia Academy of Natural Sciences.

Marginella (Volutella) ovuliformis Orbigny.

Marginella ovuliformis Orbigny, Moll. Cuba, ii. p. 101, pl. xx. figs. 33-35, 1842. (Not of Gabb, Journ. Acad. Nat. Sci. Phila., new ser. viii. p. 355, pl. 46, fig. 39, 1881; = *M. Gabbi* Dall.)

Caloosahatchie beds. Recent on the southern coast from North Carolina to Florida, and in the Antilles.

This species, distinguished by its three plaits, small size, rotundity, narrow aperture and moderately thickened outer lip, is not rare in the marls.

Marginella (Volutella) amiantula n. s.

Plate 5, figure 9.

Shell minute, elongate-egg-shaped, smooth, with involute spire; aperture rather narrow, subequal, little arched; outer lip moderately thickened, smooth inside, sulcus behind it very faint; inner lip not callous, with four oblique plaits, the anterior pair much the stronger; siphonal commissure excavated, apical commissure narrow. Max. lon. 2.5; lat. 1.25 mm.

Rare in the Caloosahatchie marl.

This little species is the most elongate and cylindrical in form of any of the species. *M. (V.) amianta* Dall, which is the most closely allied in form to this, is more pyriform, has the inner lip denticulated, the plications equal and similar, and the outer lip proportionately thicker and more prominent.

The following revision of our other previously known fossil *Marginellidæ*, which was necessarily made while endeavoring to determine the species enumerated in this paper, may be of use to some other students. The capital letters following the names refer to the formations in which they are found, Eocene, Miocene, Pliocene, Post-Pliocene and Recent. C = Claiborne sands.

M. amabilis Redfield, 1852, M. P. R.
M. americana (Conrad MS.) Redfield, 1871, E. C.; = *M. columba* Lea.
M. anatina Lea; = *M. crassilabra* Conrad.
M. antiqua Redfield, 1852, M. P.
M. apicina Menke, P. R., 1828.
M. avena (Val.) Gabb, 1881, P.
M. bella Conrad, 1862, M. P. R.
M. biplicata Lea, 1833, E. C. (non Risso); = *Ringicula* sp.
M. chrysomelina Redfield, 1848, P. R.
M. columba Lea, 1833, E. C.
M. coniformis Sowerby, 1850, M.; = *M. guttata* Dillwyn, R.

M. constricta Conrad, 1835, E. C.
M. constricta Emmons, 1858 (non Conrad), M. ; = *M. contracta* Conrad.
M. constrictoides M. and Aldr., 1886, E.
M. contracta Conrad, 1871, M.
M. conulus H. C. Lea, 1846, M. ; = *M. minuta* Pfeiffer.
M. crassilabra Conrad, 1833, E. C.
M. crassilabra Lea, 1833, E. C. ; = *M. humerosa* Conrad.
M. denticulata Conrad, 1830 (non Tate, 1878), M. P. R.
M. distans Conrad, MS., 1862, M. ; undescribed or figured.
M. eburneola Conrad, 1834, M. ; = *M. denticulata* Conrad.
M. elevata Emmons, 1858, M. R.
M. exilis H. C. Lea, 1846 (non Gmelin) M. ; = *M. subexilis* Orbigny.
M. Gabbii Dall, 1890, P. (R. ?) ; = *M. ovuliformis* Gabb non Orbigny.
M. humerosa Conrad, 1835, E. C.
M. incrassata Nelson, 1870, P. ?
M. incurva Lea, 1833, E. C. (immature and indeterminable).
M. inflexa Emmons, 1858 (non Sowerby) ; = *M. subinflexa* Redfield.
M. Jewettii Carpenter, 1856, PP. R.
M. larvata Conrad, 1833, E. C.
M. limatula Conrad, 1834, M. P. R.
M. minor, C. B. Adams, 1852, P. R.
M. minuta Pfeiffer, 1840, M. P. PP. R.
M. nana Conrad, MS., 1834 (undescribed or figured), not of Marrat, 1878.
M. oliviformis Tuomey & Holmes, 1857, P. ; = *M. antiqua* Redfield.
M. ovata Emmons, 1858, E. C. M. P. ; = *M. semen* Lea.
M. ovata Lea, 1833, E. C. ; = *M. larvata* Conrad.
M. oviformis Conrad, 1868, M.
M. ovula Conrad, 1871, M. ; = *M. oviformis* Conrad.
M. ovuliformis Gabb, 1881, P. (non Orbigny, 1842) ; = *M. Gabbii* Dall.
M. perexigua Conrad, 1842, M. (unfigured. Like an exaggerated *Willcoxii*).
M. plicata Lea, 1833, E. C.
M. pudica Gaskoin, 1849, R. ; = *M. chrysomelina* Redfield.
M. roscida Redfield, 1860, M. P.? R. ; = *M. limatula* Conrad.
M. semen Lea, 1833, E. C.
M. semenoides Gabb, 1860, E. (*Erato* s. Gabb).
M. Sowerbyi Gabb, 1873, M. (unfigured).
M. subexilis Orbigny, M. (undeterminable).
M. subinflexa Redfield, 1871, M.
M. virginiana Conrad, 1868, M. P. R.

FAMILY VOLUTIDÆ.

Before considering the systematic arrangement of our American *Volutidæ* it may be well to consider the development of the group. Eliminating *Cancellaria* and other *Toxoglossa*, the group formerly called the *Columellacea* had without doubt a common origin. The indications are pretty clear that from the Mesozoic *Fusidæ* are descended, on the one hand, *Tudicla*, *Fulgur*, *Fasciolaria* and *Latirus* ; and, on the other, *Volutomorpha*, *Volutoderma*, *Volutilithes*, *Lyria*, *Voluta*, *Caricella*, *Scaphella*, *Aurinia*, *Turbinella* proper and *Vasum*. I have not investigated the relations of *Marginella* sufficiently to venture on an opinion as to its descent.

Origin of the Plaits:—The question which first arises is as to the origin of the columellar plications and their function. In considering the dynamic relations of the animal to its shell we may obtain satisfaction on this point. In the fusiform rhachiglossa an anatomical difference exists to which I believe attention has not hitherto been called. Indeed, unless the principles of dynamic evolution are granted, it is a difference which would appear to have little or no significance. These principles, however, afford a key which seems to unlock this and many other mysteries. In the recent forms of this sort the adductor muscle, which in all gastropods is attached to the columella at a certain distance within the aperture, is attached *deeper within the shell* than in non-plicate forms. The point of attachment may be an entire turn or even more behind the aperture, while in short globose few-whorled shells and in the non-plicate forms it is, as a general rule, little more than half a turn behind the aperture.

Now let us consider the dynamics of the case. We have, reduced to its ultimate terms, a twisted shelly, hollow cone, subangulate or even channelled at two extremes corresponding to the canal and the posterior commissure of the body and outer lip. Inside of this we have a thin, loose epithelial cone, the mantle, of which the external surface, especially toward the margin, is shell-secreting; lastly, inside of the mantle-cone we have a more or less solid third cone, consisting of the foot and other external parts of the body of the animal, which can be extended beyond the mantle-cone outwardly, as the mantle-cone can be beyond the shell-cone. The body-cone and the mantle-cone are attached at one of the angles of the shell-cone some distance within the opening of the spiral of the latter. The two outer cones constitute a loose, flexible funnel within a rigid, inflexible funnel, while the body-cone forms a solid, elastic stopper inside of all.

What will happen according to mechanical principles (which can be tested by anybody with the simplest apparatus) when the mantle-cone is withdrawn into a part of the shell-cone too small for the natural diameter of the contracted mantle-cone? It must wrinkle longitudinally. Where will the wrinkles come? They will come at the angles of the shell-cone first; they will be most numerous toward the aperture, since toward the aperture the mantle-cone enlarges disproportionately to the caliber of the shell, owing to its processes, the natural fold of the canal, etc., etc.; the deepest and strongest wrinkles will be concentrated on the pillar, owing to the fact that the attachment of the adductor prevents perfect freedom in wrinkling and the groove of the canal will mechanically induce the first fold in that vicinity. The most numerous small wrinkles will be near the aperture opposite the pillar, because of the mantle-edge this is the most expanded part, and there will be a tendency to a ridge near the angle of the posterior commissure. Repeated dragging of a shell-secreting surface, thus wrinkled, over a surface fitted to receive such secretion, will result in the elevated shelly ridges which on the pillar we call plications, and on the outer lip liræ, if long, or teeth, if short. The commonly existing subsutural internal ridge on the body of the shell near the posterior commissure will mark the special conditions in that part of the aperture.

When the secreting surface is thus wrinkled or corrugated longitudinally, the wrinkles and the concave folds between them will be directed in the sense or direction in which the body moves in emerging from or withdrawing to the whorl. The summits of the convex wrinkles will be appressed more or less forcibly against the shell-wall exterior to them in which they are contained. The semi-fluid, limy secretion of which the shell-lining is built up, exuding from the whole surface of the mantle, will be rubbed away from the lines of the summits of the wrinkles and tend to accumulate in lines corresponding to the concave furrows between the wrinkles. This secretion hardens rapidly and these lines would become somewhat elevated ridges which would by their presence (when once initiated) tend to maintain the furrows and wrinkles in the same place with relation to the thus-initiated liræ, as these elevated lines are called when on the outer lip; or plaits, when situated on the pillar.

The modification referred to generally takes place during resting stages of the animal's growth, since while the animal is rapidly extending its coil the secretions seem to be directed toward the extreme margin, and the general mantle-surface resumes its secretive function (or the latter becomes active) somewhat later, after the formation of a definite varix, or thickened margin; indicating a resting stage in the animal's career. It is probable also that during rapid growth there is less compression of the tissues than during the resting stages. The external sculpture and some of the modifications of the aperture are connected with the functions of the extreme edge of the mantle; those we are at present considering relate more especially to the function of its general surface by which the layer which lines the whorls, the pillar, plaits and liræ are solely secreted and deposited.

In species with the adductor attached to the pillar near the aperture the wrinkles would be fewer, and their action, if any, confined to the vicinity of the margin of the aperture. The deeper the attachment the greater will be the compression of the secreting surface and the distance over which it is constantly dragged back and forth, and the consequent length of the ridges of shelly matter deposited. If the inner or mantle-cone had the whole cavity to itself, it is evident that it could and would infold itself in a manner which might not appress its folds against the inner surface of the rigid outer or shell-cone. But here the mass of the solid and elastic foot and external body comes into play, and by its withdrawal inward forces the wrinkled mantle-cone against the shell. The mantle is thus confined between a rigid outer and an elastic inner surface, with the result that it cannot recoil from the former and that a certain uniformity of size and direction is imposed upon the wrinkles, except where the recess of the canal allows them to become more emphatic, or to a less degree the posterior angle permits a slight expansion. The mechanical principles involved may be readily illustrated by the experiment of pulling a handkerchief through the neck of a bottle, or funnel, followed by a cork in the center. Of course, the more nearly the apparatus conforms to the form and twist of a spiral shell the more nearly the results will approximate to those of nature. It is difficult, however, to find any artificial tissue which will correspond in elasticity, or capacity for partial self-contraction, to the living tissues concerned in nature. Hence an exact conformity is not to be expected, though the mechanical principles may be reasonably well illustrated.

The folds or wrinkles of the mantle-edge in the average mollusk will not be visible, as a rule, at the aperture when the animal is living, and the question may be raised as to whether any wrinkling really takes place. To this I may reply that in those forms which have the adductor attached close to the aperture, in hardened specimens withdrawn from the shell after immersion in alcohol, there is generally no wrinkling visible, unless at the anterior and posterior commissures; but in forms with a deep-seated adductor, even the strong contraction caused by alcohol does not eliminate all the wrinkles. It is also noteworthy, in connection with this hypothesis, that in gastropods in which the edge of the shell is free from the edge of the mantle (and ridges due to insertion in the tissues, as of *Fissurellidea* or *Chiton*, are not to be looked for) there are no species which possess liræ, elongated ridges or plaits, except such as those in which the process here described is practicable. Nodes or " teeth " may be secreted without any " to-and-fro " motion, but there are no cases where long, internal shelly ridges are produced without the opportunity for such motion. This fact alone seems to me to go far toward a demonstration of the present hypothesis.

A comparison of specimens will show that the results exhibited agree with marvellous precision with the results called for by the preceding hypothesis, based on the dynamical status of the bodies concerned, their motions and secretions. The agreement is so complete as to amount to a demonstration, though in certain cases there may be complications which need additional explanation.

All this, I repeat, is purely mechanical and a result of the dynamical conditions existing in the shell and related to the mechanical movements of the animal. With the inception of the plications and liræ natural selection has nothing whatever to do. With their preservation and perpetuation it is legitimately concerned. In what way can it operate? As to this, without being dogmatic, I may suggest the following explanation:

The area of attachment of the adductor muscle is small at best, and its operation resembles a force exerted at the short end of a lever, or between the fulcrum (place of attachment) and the body moved. Any extension of the surface which would give a larger area of attachment or a more efficient attachment would in the long run be beneficial to the animal, whose safety depends largely upon its being able to withdraw rapidly and completely within its protective shelly covering on the approach of danger. Now, the development of ridges upon the pillar would give a larger area of attachment to the muscle, would greatly increase the strength of that attachment, and would incidentally strengthen the whole shell. Any one who has attempted to remove the soft parts of a *Voluta* from its shell, will have had sufficient testimony to the added difficulty due to the plications, even in the dead animal, compared with the unplicate *Buccinum* or other Rhachiglossate mollusk without plaits.

In accordance with this hypothesis we find in American rocks the plications first beginning deep in the shell of fusiform gastropods (*Piestochilus*, *Cryptorhytis*), yet having no plait visible in the aperture, as appears in the later *Terebrispira* and Tertiary *Fasciolariæ*. There is some reason for believing with Meek that this succession is also true in Europe and India, but a more thorough knowledge of the fossils is needed before this can be asserted with confidence.

I should add that the identical principles here invoked will account for the liræ and apertural denticulations of all gastropods, but those about the margin of the aperture are naturally subject to more complex stresses than those deeper within the shell. The inception of deep-seated plaits continuous on the columella, I believe to be due in all cases, as in the present one, to a deeper-seated adductor muscle, operating as above described, and which might be anticipated to occur in widely different groups of spiral gastropods, as, for instance, *Cancellaria* among the *Toxoglossa*, *Voluta* among the *Rhachiglossa*, *Petaloconchus* or *Nerinea* among the *Tænioglossa*, *Actæon* in the *Opisthobranchiata*, and in the shells of many Pulmonates. The mechanical stresses involved in each case will be the same and followed by similar results, whatever the genetic relations of the particular mollusk. Yet classification hitherto has too frequently been based largely on characters due to temporary stress, while those more deep-seated and obscure, yet fundamental, have been ignored. Of course, characters due to stress have their value, it should not be forgotten; but the differences of origin of different sorts of characters are yet largely to be worked out and discriminated.

A point which may be noted in regard to the *Volutidæ* to which my attention was called by Mr. Pilsbry, is that in this group the mantle is greatly extended and there would be more of it to be wrinkled than in such forms as *Buccinum*, etc. It may be added that the forms in which we note the beginning of plaits for this family, many of them, such as *Liopeplum* and *Volutomorpha*, had the mantle so extended as to deposit a coat of enamel over the whole shell, as in the modern *Cypræa*, so that here we have an additional reason why plication should be emphasized in this group.

Of course, as before noted, the mechanical principles are the same in any group of gastropods, but among those in which the wrinkling is confined to the region of the aperture or those shells which are lirate or dentate as opposed to plicate, several other principles come into play which may be briefly referred to in passing, In the first place, those species which have a very extended mantle, with hardly an exception have a lirate aperture (*Oliva*, *Olivella*, *Cypræa*, *Trivia*, etc.). With species in which there is a widely expanded mantle and yet no lirations, it will usually be found that the mantle is not entirely withdrawn into the shell in such forms, or is permanently external to the shell (many *Opisthobranchs*, *Marseniidæ*, *Sigaretus*, *Harpa*, etc.). In a group, like the *Cypræidæ*, where nearly all the species are lirate on both lips, there are a few which want these liræ, and these are species which have a wider aperture in the adult than most of the genus, and in which we should expect the wrinkling would be less emphatic.

In most turrited gastropods the liræ inside the mouth are not very regular in number or position compared with such forms as the *Cypræidæ*. The former are mostly species which have a nearly smooth mantle-edge without any fringe of papillæ or tentacular processes upon it and hence its wrinkling will be more or less governed by fortuitous circumstances. But when (as in *Cypræa*, many *Trochidæ*, *Turbinidæ*, etc.) the edge of the mantle is more or less regularly studded with tactile papillæ which are less contractile than the mantle itself, are thicker and regularly spaced, it will be seen at once that their presence will have a marked effect in determining the number and position of the wrinkles and consequently of the liræ, and in this way the singular uniformity in number and position of the liræ or " teeth " in such forms as *Cypræa* can be accounted for. On the other hand, if we take a form like *Ovulum gibbosum*, which has much the shape of *Cypræa*, but has no regular liræ, and examine the soft parts, we find that the margin of the mantle is devoid of papillæ, the mantle itself is extremely thin, and the aperture of the shell wide enough to receive the whole without any noticeable compression, and hence there is no mechanical reason why liræ should be developed upon its margin. Compare, for instance, on H. & A. Adams' plate xxviii. (Genera of Recent Mollusca, 1858) the beautifully fringed mantle-margin of the half dozen Cypræas there figured, with the smooth edge of the same organ in *Calpurnus* on the same plate. But, as if to show that the papillæ are not essential to the liration, though they regulate and guide its formation of the wrinkles which produce it, we see, on the same engraving, that the difference between *Ovulum* or *Calpurnus* and *Cypræa* is not merely that in the latter both lips of the aperture are lirate and in the former only one, and that often very feebly, but that in the *Cypræa* the denticulation is constant and regular, while with the smooth-edged mantle it is inconstant, irregular, feeble or even absent. So it may be considered as demonstrated that the liration is produced by the mechanical wrinkling, but regulated by the marginal appendages and the amount of compression. Shells without liræ should, by the hypothesis, in general have a mantle-margin without papillæ or with very small ones, a short adductor muscle, or a wide aperture, or all these characters combined.

Those with extraordinary denticulations of the aperture should be capable (as in *Distortrix*) of widely extending the mantle, or it should have its edge peculiarly modified. In many cases, such as the inoperculate land shells, the denticles would serve as a protection and be laid hold of and developed by natural selection in various ways. Finally, after a physiological habit of forming a certain set of liræ (or even plaits) has been acquired, we might expect them to be retained for some time, even if the original conditions which induced their initiation should to some extent be changed or partially lost in the course of the general evolution of the organic type.

Obliquity in the Plaits.—The older conchologists were in the habit of placing much stress on the aspect of the columellar plaits in matters of classification—as, for instance, whether the plaits are obliquely coiled or more nearly at right angles to the axis of the pillar. In this many modern naturalists have copied the old diagnoses without discrimination, not detecting that, with the progress of investigation, the facts now available make the old diagnoses inapplicable. The existing text-books generally emphasize such statements as this: that the *Volutidæ* are separated from the Mitras by the more horizontal plaits of the latter, and by the anterior plaits in *Voluta* being larger, while in *Mitra* the posterior plaits are more conspicuous. But a complete series of *Volutidæ* will show that almost every variety of horizontality or obliquity may be found, that the plaits are sometimes unequal and sometimes equal in size, and that the more prominent of them may be situated in either part of the series.

It is in order, therefore, to consider the circumstances which are associated with the different types of plication in this family, and to what dynamic conditions these differences may be with probability ascribed.

If one winds a cord about a cylinder, as an ordinary cylindrical lead-pencil, it will be observed that in proportion as the number of turns diminishes in the same length of pencil, the obliquity of the plaits increases. The same thing is observable in the "lay" of a rope, and if a given length of rope be additionally twisted it will at the same time be shortened.

The obliquity of an applied plait will also decrease in the same length in accordance with the increase in the diameter of the cylinder to which it is applied. The principle at bottom is the same in this as in the preceding example, for with the same axial length of cylinder the actual length of applied plait will be greater the greater the diameter of the cylinder, and it is really only another example of the proposition that in the same axial length the greater the length of the cord coiled the less oblique will be its direction.

These principles are amply illustrated among the animals under consideration.

Take the group called *Caricella* by Conrad, which is the direct ancestral line of *Scaphella* proper as typified by *S. junonia.* This group in the Eocene comprises short, bulbous forms like *C. prisca* or *C. doliata,* almost devoid of spire; and long, slender, mitriform species like *C. demissa* and *C. Leana.* The short forms have nearly horizontally coiled high plaits like those of *Turbinella,* and were therefore referred to that group as a subgenus by Conrad. The longer forms have more and more oblique plaits. The Turbinellas, an offshoot from the early *Volutidæ* (*Latirus* and its allies excluded), have a very large, stout column, and therefore nearly horizontal plaits, which are characteristic of the genus. *Aurinia dubia,* which has an extremely slender axis, has the plaits correspondingly oblique. The Mitras, which have many turns in a given length, are notable for their horizontal plaits. The few species which have few whorls have more oblique plaits, and one of the finest examples of this sort in the genus *Mitra* was referred to the *Volutidæ* by Conrad on that ground, under the name of *Pleioptygma.*

In species whose body when retracted solidly fills the whorls, the coil of the plaits must, as it always does, conform to the general spiral of the whorls. In species, of which there are a few, in which the body is peculiarly slender, though an expansive mantle forms a capacious whorl, the plaits resulting may be more oblique on the pillar than is the general coil of the spire, and thus a few apparent exceptions are accounted for. This is a matter of observation as well as theory.

Number and Form of the Plaits.—In the first initiation of plications, as already pointed out, the greatest emphasis will appear parallel to the canal or on the edge of the pillar, where a single strong plait will first be formed, with the possibility of others less well defined and smaller behind it. The theory is in absolute accordance with the facts observed in *Cryptorhytis, Piestochilus, Volutomorpha, Liopeplum* and *Volutilithes.* In the latter, which in its typical form belongs to the earliest Tertiaries, we have a strong anterior plait and a few less definite, closely adjacent, posterior ridges. It is evident, however, that a few elevated thin plaits would afford a larger area of attachment and a better fulcrum for the adductor muscle than a mass of obscure, little-elevated ridges. To natural selection, therefore, I would ascribe the speedy development of the former type and the rather rapid decrease in the number of species with the latter type of plications, so that at present only one or two living species are known, while in the early Tertiaries it was the dominant type. I should state, perhaps, that those plaits which follow the pillar into the spire are alone under consideration, those accessory ridges about the aperture being, like the liræ of the outer lip, of a very subordinate importance. With the increase in size and elevation is associated a reduction in number of plications until what may be supposed to be the most advantageous number is arrived at. In such species as *Scaphella magellanica* Sby., where the primary plaits are not very prominent, the tendency to develop feeble accessory ridges often asserts itself.

In the large and thin species such as are usually associated under the form of *Cymba* and *Melo*, the axis is almost or quite pervious, and, instead of a central solid axis or pillar, we have a thickened edge corresponding to a very slender and twisted columella. In these species, according to the rule above cited, the plaits are very oblique. In a few fossil forms, in which, with the general characters of *Cymba*, is associated a thick and solid pillar, the plaits are more horizontal, thus according with the theory.

The existence of a long canal giving a slender shape to the shell does not necessarily imply that oblique in-and-out motion of the animal which would result in oblique plication. If the whorls, apart from the canal, are closely coiled and the canal is somewhat constricted off from the whorl behind it, the in-and-out motion of the animal will be transverse to the axis rather than obliquely along it, and horizontal plaits will result, as in *Turbinella pyrum*, notwithstanding the elongated form which the narrow canal gives to the shell.

The factors leading to the development and especially those influencing the form of the plaits are complex, and it may be difficult, some may think it impossible, to assign to each its proper weight in producing a given result. But this complexity is a part of the much greater complexity of Nature, and the attempt to interpret it must reckon with the inherent difficulties in any event. There is no short and easy byway to a genuine comprehension of Nature. Yet I think it has been shown with sufficient clearness that dynamic and not selective influences are the chief factors in the minor problem now under consideration.

Characters in the Nucleus of Volutidæ.—In the group under consideration we are fortunate in having one feature which enables us to understand something of the embryonic or larval history and thereby to partially substantiate the hypothesis as to descent drawn from other characters. I refer to the characteristics of the larval shells.

In the Mesozoic transition-forms the larval covering was shelly and minute, its upper surface like a minute *Conulus* or *Hyalinia*. This indicates that those forms found their benefit in the production of a large number of small shell-bearing larvæ rather than in a small number of large ones. This holds good for all the Mesozoic forms, at least in America, and for all the exotic Mesozoic forms I have been able to examine. These small larval shells are persistent and often of a different texture from the succeeding whorls of the adult.

This, being observed, has been described as a " papillose " apex, a grossly inaccurate use of a term which was originally intended and is still chiefly used to denominate a subglobular, few-whorled, inflated nucleus like that of *Tudicla*. Indeed, Deshayes and other paleontologists have used a single term such as " mamelon " to denominate the larval shell of all Volutes, regarding the differences as merely of size. He says (An. sans Vert. bassin de Paris, III. p. 582), " La mamelon existe sans exception dans toutes les Volutes, aussi bien dans les fossiles que dans les vivantes, " while allowing them " une coquille embryonnaire quelquefois énorme et d'une forme toute particulière. "

There are at least three well-defined types of Volute larvæ among the species of the Parisian Eocene, and when we regard the extreme subdivision of the fossils of this area into nominal species practiced by Deshayes, and admirably illustrated, it seems extraordinary that such peculiar and remarkable characters as the larval shells offer should have received from him so little consideration.

We may classify the larval shells broadly into two groups, those which were shelly from the beginning and those which have succeeded to a horny or uncalcified protoconch which is lost before the larval shell escapes from its ovicapsule.

In general, the advance in biologic rank of any group in process of evolution is marked, if by any change in the larval conditions, by a decrease in the number of embryos and an increase in size of the individual larvæ. In *Purpura* and *Buccinum* it has been shown that a diminution of the total number is caused by the cannibalism of certain inmates of the same capsule which devour their mates, consequently through this extra diet becoming larger and more sturdy than the embryos less unscrupulous, but which may also chance to survive. At all events, great disparity may be observed in the size and development of larval specimens contained in a single capsule and ready to emerge, not only in the above-mentioned genera, but more markedly in *Chrysodomus* and *Volutopsis*, both of which are related to the *Volutidæ*, the latter having ovicapsules identical in form and construction with those of *Scaphella magellanica* and *Volutilithes Philippiana;* though the last mentioned are much smaller.

The latter part of the Mesozoic time for the *Volutidæ* seems to have been a sort of springtime, when important changes were inaugurated, new characters initiated, new lines of development begun, while the particular species varied as if in a state of flux. By the end of the Eocene the group seems to have recovered its equilibrium, less fortunate experiments having fallen by the wayside and the well-defined groups, recognizable in recent fauna and in the later Tertiaries, being pretty well established.

When the *Volutidæ* first begin to appear and branch off from *Fusus*, *Fasciolaria* and *Turbinella* the nucleus or larval shell in all these forms was small and shelly, as already stated.

I have identified this form of nucleus in *Volutoderma* (or *Rostellites*), *Liopeplum* and *Volutilithes*. In the latter it is generally well preserved and can be observed by anybody. The other forms are generally so imperfectly preserved as to make it a rare occurrence for the nucleus to be found uninjured.

There are several forms of the shelly nucleus. It undoubtedly preceded the horny one in this group. The original and most common type I may call the *trochiform nucleus* (See Pl. 6, fig. 3). Externally its spire appears conical or trochoid, polished, unsculptured, and of few whorls. This is the case in *Liopeplum* and the earlier types of *Volutilithes*, as well as the Fusoid forms from which they sprang. A variation sometimes observed is one in which the cone becomes flat above, resembling a *planorboid* coil. This is occasional in *Volutilithes* as an individual " sport," but is habitual with some later species. Another form, developed from the trochoid, differs less in size of its initiatory whorls, but contains more whorls, which increase but little in diameter transverse to the axis. This may be termed a *pupiform nucleus* (See Pl. 6, fig. 3 a). Still another important step is taken when the larval shell becomes larger, bulbous or subspherical, one-sided and inflated. The number of whorls is less and the nucleus is generally slightly larger than the next succeeding whorl. I shall refer to this as the *bulbous nucleus.* It is usually unpolished when perfect and attracts attention by its want of symmetry with the regular coils of the spire succeeding it.

Lastly we may mention the enormous nucleus observable in many recent and a very few late fossil forms where the trochoid type has become greatly exaggerated and the visible surface of the nucleus in the adult is dome-like and as large as the end of a pigeon's egg. This differs from the trochoid type chiefly in size and may be called the *Melo nucleus*, as (though not confined to that group) it is typical of the subgenus *Melo* as contrasted with *Cymba.* There are all gradations of size between the *Melo* form and the ordinary trochoid nucleus. The medium sizes are apt to exhibit transverse waves or riblets and rarely faint spiral lines.

Of course, all these names refer merely to the appearance of the outer surface of the posterior aspect of the spire of the larva. The anterior part of the shell is always canaliculate.

Turning to the second type which begins with a horny protoconch, it may be observed that the discovery of that type is very recent, and until announced* the key to a full comprehension of the meaning of the nuclear shell in *Volutidæ* was wanting.

The origination of this group must have taken place about the end of Mesozoic time. I have seen a single Cretaceous species which probably should be referred to it, though the nucleus was imperfect. The group was partly recognized by Conrad in 1866, but he did not at that time have data for placing its validity beyond a doubt.

In the typical form the larva is clothed with a cuticular or horny protoconch, probably similar in form to that which when shelly results in the " bulbous nucleus " of the other line of descent. Later on, but while still in the ovicapsule, the deposition of limy matter begins as a slender cone or elevated point along the line of the axis of the protoconch, and as the larva grows the posterior part of the mantle secretes a shelly dome. Being thus cut off from the horny protoconch, the latter falls into shreds and is lost. The nucleus of the larva, still in the ovicapsule, then presents a slightly irregular dome, with a slender point rising from the apical part (Pl. 6, fig. 5). So much is a matter of observation in the living *Scaphella magellanica* Sby. In some other forms the elevated point is almost or entirely wanting (Pl. 7, fig. 9); these are usually those with large larvæ, in which the upper profile is irregularly dome-like and the surface granular or unpolished. The last term of the series, corresponding to *Melo* in the other line of descent, is furnished by *Cymba*, in which the nucleus is enormous (Pl. 7, fig. 1), but apparently secondary to a protoconch, though I judge merely from the aspect of very young shells. Since the forms which first show the pointed nucleus (Pl. 7, fig. 3) were named *Caricella* by Conrad, I shall refer to that as the *Caricella nucleus*, the larger and pointless kind may be called the *Scaphella nucleus*, and the last dome-like form the *Cymba nucleus*.

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* **Dall, Blake Gastropoda,** Bull. Mus. Comp. Zool. xviii. p. 452, 1889; Proc. U. S. Nat. Mus. xii. p. 311, pl. ix. figs. 5, 6, 1890.

I may observe that, owing to the abominable practice of dealers, who grind and polish every Volute which comes into their possession until the nucleus retains none of its original features, it is almost impossible to tell with accuracy what sort of nucleus the recent Volutes possess. I have been fortunate in getting a number of specimens which came to me direct from the collector, and from which I have learned more than any one could get from the best museum collections I have seen. The latter are always ground, filed and polished, or acidulated and polished. The collection of the U. S. National Museum has escaped little better than many others. Fossils are often in much more perfect state. No one considers them worth polishing, and they are allowed to remain in a state of nature. I would warn any one who may feel disposed to test the observations of this paper by a study of recent specimens in museums, that they will find it next to impossible, in those forms with small or medium-sized nuclei, to get at the truth at all.

The original stock from which this type was derived I believe to be the earliest form of *Volutilithes* or the stock from which the cancellated *Volutilithes* themselves descended. My reason for this is that in the Tertiary and recent forms (except *Cymba*) almost without exception the whorls of the adult spire which immediately follow the larval shell exhibit a sculptured or cancellated surface (Pl. 6, fig. 6, Pl. 7, figs. 2–5, 8, 9) similar to that of those ancient fossils, and of the two species of recent *Volutilithes* (Pl. 6, fig. 4); a surface unlike that of any of the true Volutes, which distantly approach it only in *Fulguraria*. This peculiar sculpture must have been very strongly impressed upon the organism, since the character is preserved intact from the beginning of the Eocene down to the recent species, though only on the earliest whorls. It is often eaten off by acid in museum specimens of *S. junonia*, but in a fresh specimen is beautifully distinct (Pl. 7, fig. 9).

I will now tabulate the nucleus forms, with examples of each type in which I have positively ascertained its existence from unmutilated specimens or authentic information.

VOLUTOID SERIES.

1. Trochiform Type (Pl. 6, fig. 3).

A. Nucleus small, simple.

CRETACEOUS. *Rostellites navarroensis* Shumard, *R. Gabbii* White (*fide* Gabb); *Liopeplum* (*Lioderma*) *lioderma* Conrad, *L. Spillmani* Tuomey; *Volutomorpha eufaulensis* Conrad.

EOCENE. *Volutilithes petrosa*, *Sayana*, *rugata* and *limopsis* of Conrad; *V. Haleanus* Whitfield. In Europe *V. spinosa*, *bulbula* and *labrella* Lamarck; *V. luctator*, *lima* and *ambigua* Sowerby; *Lyria harpula* Lamarck (partly). *Lyria* sp. ind. (Prairie Creek beds, Lower Eocene, Miss.); *L. Edwardsi* Arch, non Desh.

MIOCENE. *Lyria mississippiensis* Conrad, *L. pulchella* Sby., *L. musicina* and *zebra* Heilprin. In Europe *L. costata* Sowerby, *L. simplex* Brocchi, *Athleta rarispina* and *A. ficulina* Lamarck.

PLIOCENE. *Volutilithes D'Orbignyana*, *Domeykoana* and *gracilis* Philippi, *V. triplicata* Sowerby; *Lyria* sp. (Costa Rica).

RECENT. *Volutilithes Philippiana* Dall and, probably, *V.* (*Volutocorbis*) *abyssicola* Adams and Reeve; *Lyria* sp. (probably nearly all the species); *Enæta* sp. (W. Am.).

B. Nucleus small, planorboid, smooth.

EOCENE. Rare individuals of *Volutilithes petrosa* and *Lyria harpula* Lamarck.

C. Nucleus larger, sculptured, trochoid or planorboid (Pl. 6, figs. 7, 8).

PLIOCENE. *Voluta musica* Linné, *Voluta* sp. (Costa Rica).

RECENT. *Voluta musica*, *virescens*, *vespertilio* and *Norrisii*; without radiating sculpture, *V. undulata*,* *V. reticulata*, *Ellioti* and *Angasi*.

D. Nucleus of *Melo*, very large.

RECENT. *Voluta scapha*, *magnifica*, *imperialis*; *Melo indicus* and all the other species of *Melo*.†

E. Nucleus pupiform. (Pl. 6, fig. 3 a).

EOCENE. *Voluta cithara*, *lyra* and *musicalis* Lamarck.

MIOCENE. *Voluta elegans* Grateloup.

2. Bulbous Type (Pl. 6, fig. 5 a; Pl. 7, fig. 10).

EOCENE. *Lyria?* sp. (Texas Eocene). *Voluta Newcombiana* Whitfield. Some specimens of *Lyria mississippiensis* Conrad and *L. harpula* Lamarck, though very small, are bulbiform.

MIOCENE. *Lyria zebra* Heilprin, probably, some specimens.

PLIOCENE. (?)

RECENT. *Voluta rupestris* Gmelin (typical and large), *V. hebræa* and *V. vexillum* Lamarck.

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* I find the nucleus of this species trochiform and of moderate size, hardly "small" and certainly not "pointed," as stated by authors.

† The Cretaceous *Melo pyriformis* is not a *Melo*. The few species referred to *Melo* from rocks earlier than the quaternary belong elsewhere. The group is not known earlier than the quaternary.

Among the forms which retain the small *Volutilithes* or Trochoid nucleus in the Eocene, a tendency to variation is clearly observable. To become less regular in form and larger is the tendency. *V. cithara* illustrates increase of size without loss of regularity, but the most significant changes are in small nuclei, such as those of *Lyria*, which begin to appear swollen and asymmetrical. This leads to such nuclei as those of *Voluta virescens* Lam., and through these to the still larger and more ornate nuclei like those of *V. musica* and further on *V. vespertilio*, on the one.hand, and on the other to larger, but unornamented nuclei, as in *Voluta magnifica* and *Melo indicus*, regularity of form being eventually resumed.

SCAPHELLOID SERIES.

1. *Caricella* type of nucleus (Pl. 6, figs. 5, 6; Pl. 7, figs. 2-5, 7, 8).

EARLY EOCENE. *Caricella Leana* Dall, *C. Wetherelli* Sowerby, *C. doliata* Conrad (occurring in the order named). *Voluta Showalteri* Aldrich.

MID-EOCENE. *C. prisca, prætenuis* and *C. pyruloides* Conrad; *C. podagrina* Dall. Paris Basin *Voluta* (*Eopsephæa*) *muricina* and *costaria* Lamarck; *V. torulosa, neglecta* and *Edwardsi* Deshayes, *V. mixta* (Chemn.) Nyst.

UPPER EOCENE. *Caricella reticulata* Aldrich, *C. subangulata* and *C. demissa* Conrad; *Lapparia pactilis* Conrad, *L. Mooreana* Gabb, *L. dumosa* Conrad.

MIOCENE. *Scaphella Trenholmii* T. & H. and *S sinuosa* Conrad (probably). *S. striata* Gabb, *Scaphella obtusa* Emmons, *S. solitaria* Conrad, *Aurinia mutabilis* Conrad, *A. typus* Conrad. *Voluta Tarbelliana* Grat. fide Conrad.

PLIOCENE. *Scaphella floridana* Heilprin (probably).

RECENT. *Scaphella ancilla* Solander, *S. magellanica* Sowerby; *S. angulata* Lamarck (possibly); *Aurinia dubia* Broderip, *A. Gouldiana* and *A. robusta* Dall.

2. *Scaphella* type (Pl. 7, fig. 9).

PLIOCENE. *Scaphella Lamberti* Sowerby, *S. aurisleporis* Sby.; *S. brasiliana* Lamarck (probably); *S. tuberculata* Swainson. *S. Trenholmii* Tuomey & Holmes?

RECENT. *Scaphella junonia* Hwass; *S. brasiliana* Lam. (probably).

3. *Cymba* type (Pl. 7, fig. 1).

CRETACEOUS. *Eucymba* (*Voluta*) *deperdita* Goldfuss, and *E.* (*Melo*) *pyriformis* Forbes.

EOCENE. *Eucymba ocalana* Dall.

RECENT. All the species of *Cymba*, *C. olla*, etc.

It may be admitted that between the *Caricella* type and the *Scaphella* type of nucleus the difference is but slight, yet I have thought it best to keep it discriminated. It is not safe to say that the apical spur of the *Caricella* type is normally absent until a shell fresh from the ovicapsule has been examined, as I have been able to do in the cases of *S. junonia* and *S. brasiliana*. In the case of *S. Trenholmii* and *floridana* the spur is on the point of disappearing and in the next generation or specific descendant, *S. junonia*, it has disappeared.

The early *Cymba* forms are so poorly preserved, as a rule, that details of the nucleus are very difficult to make out with confidence. The ancient forms differ from the recent *Cymba* in having a flattish apical nucleus and a solid straight pillar, for which reason I separate them subgenerically as *Eucymba*. They seem, when young, to have a much more slender canal, and when adult to be of a more globular shape, and hence with more horizontal plaits than the recent *Cymba*.

The early whorls and nucleus of *Lapparia* Conrad (Pl. 6, fig. 6) are unmistakably caricelloid and the shell belongs to the *Volutidæ*, though the species have been referred to *Mitra*, *Fasciolaria*, *Cordieria*, etc. They have a very *Mitra*-like aspect, apart from the nucleus, and range from the Middle to the Upper Eocene. The nucleus of *Voluta* (*Scaphella*) *angulata*, when cleared of callus, appears to have been caricelloid, but may possibly have wanted a spur.

We may now consider the group systematically in the order of its development.

CRETACEOUS FORMS.

The material is not available for a complete statement of the characters and distribution of the Cretaceous *Volutidæ*. Three groups are distinguishable in the later Cretaceous forms of North America, most of which are most fully developed in the Ripley group, which forms the transition between Cretaceous and Eocene in the East, and the Chico-Tejon series, which are in a similar situation west of the Sierra Nevada.

Genus **ROSTELLITES** Conrad, 1855.

Type *R. texana* Conrad, Eagle Pass, Texas.

The type is probably identical with *Rostellaria indurata* Conrad (1849), from the Chico series of Oregon. The group was subsequently named *Volutoderma* Gabb (1876), and species belonging to it have been referred to *Volutilithes*, *Fulgoraria*, *Fasciolaria*, etc. It is characteristic of the Cretaceous formation. American species referable to it are *R. texana* Conr., *R. indurata* Conr., *R.* (*V.*) *Navarroensis* Shumard, *R. Gabbii* White (=*Navarroensis* Gabb non Shumard). In Prof. Whitfield's unpublished report on the Gastropods of the Cretaceous Marls of New Jersey, which he has generously allowed me to consult, the following species are referable to this genus: *R.* (*Volutoderma*) *biplicata* Gabb, *R.* (*V.*) *ovata* Whitfield, *R. nasuta* Gabb, *R. angula* Whitf., *R. texturata* Whitf., *R. Abbotti* Gabb, *R. biconica* Whitf., and *R.* (*V.*) *intermedia* Whitf. As many of these names depend upon internal casts, it is probable that the number of species, if proper data were available, would prove to be considerably smaller, especially as those species which are well known are known to be very variable in form.

In the Cretaceous of Brazil *Volutilithes alticostatus* White, and *V. radula* Sby., may possibly be related to this group, but the latter is more like true *Volutilithes*.

In the Cretaceous of India *R.* (*Fulgoraria*) *elongata* (Orbigny) Stoliczka and *multistriata* Stol. should be placed here, also *R.* (*Fasciolaria*) *rigida* Bailey, *R.* (*F.*) *carnatica* Stol. and *R.* (*F.*) *assimilis* Stol. I am also of the opinion that *Ficulopsis pondicherriensis* of Forbes, figured by Stoliczka, is a species of this genus in which the spire is very greatly shortened, and that the pyriform shape has no special significance. It is dangerous to base opinions on figures, however good, or I should be tempted to include in this list several of Stoliczka's Lyrias and Volutilithes. His *Gosavia indica*, though a mere fragment, has the external sculpture of *Rostellites*, and the Pleurotomoid notch is no greater than appears in many of the earlier *Volutidæ*, including several species of *Rostellites.*

In the Cretaceous of Europe are several forms which should be referred to *Rostellites*, such as *Pleurotoma spinosa* Sowerby (Gosau), *Volutodermia fenestrata* (A. Röm.) Holzapfel, *V. Zitteliana* and *V. Gosseleti* Holzapfel (Aachen). The relations of such species as " *Volutilithes* " *subsemiplicata* Orbigny to this group are worth investigating.

The genus *Rostellites* is characterized by a usually thick shell with a tendency to cancellated sculpture of distant narrow ridges, more or less nodose at the intersections; by an acute apex and trochoid, minute nucleus; by a tendency to a notch or sulcus in the outer lip near the suture; and by the presence of several well-differentiated plaits on the pillar. A few species are thin and the form is extremely variable. The surface is not glazed, the pillar is nearly straight, and the incremental lines are conspicuous.

Holzapfel (Zitt. Paleont. xxxiv. p. 87, 1888) has discussed the relations of the group, which he refers to the *Pleurotomidæ*. But, since the publication of his paper, I have been able to examine the soft parts of *Aurinia dubia*, with the result of showing conclusively that the notch which is more or less general in *Volutidæ* and *Harpidæ* is not functionally homologous with that of the *Pleurotomidæ*. In the latter it allows the anal dejections to escape without fouling the water by passing in front of the gills. In *Harpa* and in *Aurinia* it gives passage merely to a fold of the mantle by whose periodical expansion the glaze which covers the spire is deposited on the outside of the shell. *Aurinia* presents many points of resemblance to the groups of *Volutomorpha* and *Rostellites.* The spire is glazed, the pillar is remarkably straight, the plaits are few, the whole surface is sculptured. In the recent *Volutilithes Philippiana* from the Pacific off the coast of southern Chile, there is a slight posterior undulation which is quite as prominent as that of some species of *Rostellites.* Though *Rostellites*, as far as known, exhibits no glaze, the extremely closely related *Volutomorpha* is very much glazed over, and has a more prominent notch, while in *Liopeplum* the glaze is still more profuse and the notch or sinus is distinct. In *Volutilithes petrosa* the sinus is as strong as in many *Pleurotomidæ*, and the glaze is often so massed up as to practically amount to a deformity. It is evident, therefore, that we are not obliged to regard *Rostellites* as in any way connected with the *Toxoglossa.*

Genus **VOLUTOMORPHA** Gabb, 1876.

Type *V. Conradi* Gabb, New Jersey.

Of the three species referred to this group by Gabb, one, *V. delawarensis* is an internal cast of doubtful relations; *V. eufaulensis* Conrad, is known from well-preserved specimens, and *V. Conradi*, although an internal cast, is with little doubt congeneric with the *V. eufaulensis.**

Volutomorpha is sculptured very much like a worn *Rostellites*. It differs from *Rostellites* in being covered with a thin glaze all over, and in having one large plait near the edge of the pillar instead of several subequal plaits. There is sometimes an excavation behind the plait the posterior edge of which might be mistaken for a second obscure plait. There is a notch or sulcus near or at the suture, very strongly marked at the resting stages of the animal. The nucleus is minute, polished, trochoid. The very young (not larval) shell has all the characters of *Piestochilus* Meek. The adult shell is thick, the pillar straight; in the mature shell the plait lags behind and is hardly perceptible from the aperture; while in *Rostellites* it is strong to the end, in the species I have seen.

These shells, like *Rostellites*, may reach a length of five or six inches. I should add that in Conrad's restoration of *Volutilithes eufaulensis* (Journ. Acad. Phil., 2d ser., v. pl. 47, fig. 18) the sculpture is represented as much too sharp. It has, on the whole, a feeble and obsolete look. *Volutomorpha* may be regarded as a link between *Rostellites, Liopeplum* and *Volutilithes*, combining some of the features of each. *Ptychosyca* Gabb may be a synonym. There are a large number of nominal species, based on casts, from New Jersey, etc., which may belong to this group.

Genus **Liopeplum** Dall, 1890.

Plate 6, figures 12, 12 a.

(*Lioderma* Conrad 1865, not Marseul, 1857.)

Type *L.* (*Athleta*) *lioderma* Conrad, *op. cit.* pl. 46, fig. 32. Ripley Sands, uppermost Cretaceous of Mississippi.

Lioderma Conrad, beside the type, includes *Volutilithes cretacea* and "*Conus*" *canalis* Conrad, as well as two or three elegant and still unpublished species in the National Museum collection. It seems, so far, to be confined to America. The name is preoccupied in *Coleoptera*, and I suggest in its place the name *Liopeplum.*

Liopeplum is of smaller size than the two preceding groups. It is characterized by a minute trochoid nucleus, ribbed early whorls and smooth body-whorl in the adult, all covered with a most elegant and polished glaze; also by its habit of depositing a band of callus above the suture on the periphery of the preceding whorl. The pillar is stout and slightly curved, and the plaits are three or more, weak and rather variable, somewhat as in *Volutilithes.* The sinus at the suture is notable, but not very wide.

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* By a typographical error Proc. Phil. Acad. Sci. 1876, p. 290, *cretacea* is printed instead of *eufaulensis*, but the reference to plate and figure settles the species meant.

The plaits are preceded on the pillar by a thin mass of glaze which extends over the well-marked siphonal fasciole, somewhat as in some Olivas, but with less defined boundaries. The plaits are not well visible at the aperture and are situated on the thickest part of this callus.

These are very beautiful fossils, though poorly preserved in most cases, and the genus seems to me valid.

In Tryon's Manual of Structural and Systematic Conchology, pl. 54, fig. 31 of the second volume exhibits a copy of the figure of the Eocene *Volutilithes rugatus* of Conrad as a representation of *Lioderma.* This is due to an error of the draughtsman.

In 1854–5, Prof. M. Tuomey described briefly several species of *Voluta* from Alabama. The types are supposed to be lost and the species were never figured. *V. cancellata* Tuomey was probably a *Rostellites.* *V. Spillmani* Tuomey was probably a *Liopeplum,* and very likely one of the species undescribed in our collection, which is small, with faint ribs on the spire and spiral threads anteriorly in the young. *V. jugosa* Tuomey, having a preoccupied specific name, was called *V. subjugosa* by Gabb. It is probably the same as a strongly ribbed *Liopeplum* in our collection. *V. fusiformis* Tuomey (*non* Sw.) = *V. Tuomeyana* Gabb was described from a cast and is unrecognizable. These forms were probably obtained from the Ripley group, and were described in the Proceedings of the Philadelphia Academy of Natural Sciences for 1854–5, pp. 168, 169. I have figured what I suppose to be two of them, Plate 6, figs. 12, 12a.

Genus **Volutilithes** Swainson, 1831.

Plate 6, figures 1, 3, 4.

Types *Voluta spinosa* Lam. and *V. luctator* Sby. There are no species of this group in the Cretaceous of North America. This genus begins in the Cretaceous and reaches its maximum in the Eocene. To properly assort its members would require much more time and material than at present are at my command. It gradually decreases in number of species until only one typical species (*V. Philippiana* Dall) and a second belonging to another section (*V. abyssicola* Ad. & Reeve) are known in the living state. Both are found in deep water, where they appear as remnants of a fauna mostly extinct in shallow water. The genus may be divided into subgenera as follows :

Subgenus **Volutilithes** s. s.

Type *V. spinosa* Lamarck (Pl. 6, fig. 3, young).

Shells of small or moderate size, with a small trochoid nucleus, acute spire, rather straight pillar, axially ribbed and transversely striated, with the ribs more prominent; plaits consisting usually of a stronger anterior and a number of smaller, not very regular, crowded, posterior ridges ; the outer lip is sharp, slightly reflected, lirate within, hardly thickened; the whorls are slightly turrited, usually coronated with angles or pointed spines at the shoulder, with a sinus or inflection of the lip near the suture and a thin callus on the inner lip, often continued over the whorl above the line of the suture, as in *Harpa*. Under certain conditions this callus may become hypertrophied, and the whorls, being continued over it, become somewhat irregular and, as it were, deformed. Specimens of *V. petrosa* Conrad, thus distorted, were very naturally referred by him to *Athleta* under the name of *A. Tuomeyi.*

In the American Eocene the following species of this group are known: *V. petrosa* Conrad (+ *impressa* Conr. + *dumosa* Conr. + *symmetrica* Conr. + *indenta* Conr.), *V. Sayana* Conrad, *V. rugata* Conrad and *V.* (*Mitra*) *Haleana* Whitfield. In Europe, *V. spinosa* Lamarck, *V. luctator* and *V. ambigua* Sowerby may serve as examples. *V. californiana* Conrad, turned out to be a distorted *Conus*, and as there was already a *Conus* so named, it received the name of *C. Remondi* from Gabb.

Subgenus **Volutocorbis** Dall.

Shell resembling *Volutilithes*, but more slender and without a coronated shoulder; the sculpture is reticulate and nodose or prickly at the intersections; the sutural sinus is less evident than in *Volutilithes*, and the suture is sometimes channelled.

Type *V.* (*Volutilithes*) *limopsis* Conrad. Lower Eocene of Alabama.

In Europe *V. lima* Sowerby and *V. digitalina* Lamarck will serve as examples, in the recent fauna *V. abyssicola* Ad. & Rve.

There are a few species like *V. bulbula* and *V. labrella* Lamarck which are smooth or have merely a carina on the shoulder, and when adult would appear to be out of place in either this or the preceding group. But an examination of the early whorls will show that they really belong to *Volutilithes* proper, of which they are merely aberrant specific forms.

Subgenus **Athleta** Conrad, 1853.

Type *A. rarispina* Lamarck, Miocene of Europe.

This is a short-lived type, exhibiting but one or two species. It is foreshadowed by the distorted specimens of *Volutilithes petrosa* to which I have already referred, and which occur from the lower Eocene of Alabama (Wood's Bluff) up to the Claiborne sands and the beds known as Jackson, overlying the Claiborne, associated with the undistorted normal form, which is always more numerous. In America, however, the deposition of callus never became normal and regular, though in Europe *A. rarispina* and *A. ficulina* Lam. exhibit a normal, *Cassis*-like expansion around the aperture of what, without it, is a typical *Volutilithes*. The establishment of the European forms took place in the Miocene, which period they did not survive. The subgenus forms a short side-branch from the typical *Volutilithes* stem, which, apparently, started as a pathologic variety in the American Eocene.

As the era of *Volutilithes*, especially the Eocene part of it, was one when the group was, so to speak, pregnant with evolutionary possibilities, it is as well not to attempt a fine-drawn separation of its species into sections. In order to point out the lines of variation, then hardly more than specific, but which have since become differential of genera and subgenera, I will here indicate the suggestions which have resulted from a study of the material hereinbefore referred to.

In the Cretaceous period, I believe the modifications of the intracapsular development had already been initiated. The small shelly, trochoid nucleus, which had been inherited from the fusiform ancestry of the group, of course existed, as we have shown; the large *Cymba* nucleus, which in recent species is associated with the development of single individuals in the matrix of the parent and not in a capsule deposited on some foreign object, had already been developed. The steps between these are wanting at present, owing to the imperfection of the geological record. But I regard *Rostellites* and *Volutomorpha* as probably representing the ancestry of the true *Volutilithes* in our American rocks, and *Volutocorbis* and *Volutilithes* as the Eocene examples of analogous surface-structure.

In the Eocene, however, the links between the different branches of this stock appear to be pretty well indicated. A large series of any one species will show occasional instances of variation in the nucleus to vary from the normal type. It tends to become bigger, more irregular and swollen. The gap between *Volutilithes* and *Voluta* is not wide. An enlargement of the shelly nucleus, a tendency of the sculpture to become more rounded, less spinose and less sharp; and for the ribs to become emphasized rather than the spirals; the failure of the internal liræ on the outer lip and an increase of them on the inner lip (changes probably connected with a widening of the adductor attachment on the pillar), and the change was accomplished (see Pl. 6, figs. 1, 2). A careful study of a series of the specimens shows how very slight the modification really is.

The recent *Volutilithes Philippiana* has no operculum, but, being a deep-water shell, this might be a recent modification. I think all the Eocene *Volutidæ* probably had opercula. The dentition of the recent *Volutilithes* is, as one might expect, rather generalized in form. It has the wide, rather straight rhachidian base of *Voluta*, but only the three simple cusps of *Lyria*. We can separate the typical *Voluta* (*musica* L.) from *Lyria* by its dentition and its larger and more sculptured nucleus. *Voluta* thus typified would seem to be modern and not to be definitely traced back of the Pliocene, as far as we now know. The Eocene species of this type would better all be referred to *Lyria*, of which *Otocheilus* Conrad is a synonym. I find the prototype of *Voluta musica* in the Miocene *Lyria mississippiensis* Conrad, which is identical with the older *Lyria costata* Sowerby. But the type appeared earlier in Europe, as is witnessed by *Lyria harpula* of Lamarck and one or two closely allied forms from Barton and the Paris Basin.

Section *Volutopupa* Dall.

There are a few curious species in the Paris Basin Eocene which are really aberrant species of *Volutilithes*, if we may be permitted to judge from the characteristics of their sculpture, which, as far as it goes, is sharp with a spinose tendency. They agree in having a high, smooth nucleus of many volutions, its characteristics being those of the *Volutilithes* nucleus, but with more whorls, indicating a longer intracapsular life. I regard these forms as constituting a short lateral branch not extending higher than the Miocene, and not, as has been thought by some, precursors of the *Voluta musica* type. For them it will be convenient to form a section, *Volutopupa*, of the genus *Volutilithes* (Pl. 6, fig. 3 *a*).

I have referred to the short step from *Volutilithes* to *Lyria*. I figure a species of *Volutilithes* (Plate 6, figure 1) which needs only to have the sharpness of its sculpture a little rounded and the liræ effaced from its throat to be an excellent *Lyria*.

It is notable that after *Volutilithes* all the *Volutidæ* are destitute of the above-mentioned liræ. The denticulations of the edge of the lip as in *Fulgoraria rupestris* are a function of the external spiral sculpture and have nothing to do with the true liræ.

The internal thickening of the outer lip in the adult of some recent species of *Lyria* has been regarded as a systematic character, but this is rarely found in the fossil species, and is exceptional even in the recent ones. It is a very modern character, and may be regarded as a step toward the subgenus *Enæta*, which I believe has not been found in a fossil state.

The bulbous form of shelly nucleus, so well typified by the recent *Fulgoraria rupestris*, was initiated as early as the Eocene in America. It is very difficult in rubbed specimens to distinguish the bulbous nucleus from some variations of the *Caricella* nucleus (see Pl. 7, fig. 4). I have even had my doubts as to whether *Fulgoraria* was not Scaphelloid. Still, it seems pretty certain that the protoconch in *Fulgoraria* is really shelly, and in *Eopsephæa* membranous. The origin of the bulbous nucleus is indicated by the minutely bulbous form of the apex in some individuals of Eocene and Miocene forms of *Lyria*. *Voluta virescens* (Pl. 6, fig. 7) is intermediate between the trochoid form of *Voluta* (typical Pl. 6, fig. 8) and the bulbous form of *Voluta vexillum*. It seems very probable that the passage was from the trochoid to the small bulbous, and from this to the large trochoid and large bulbous nucleus, respectively. I figure the tip of an unpublished Eocene species of *Voluta* or allied genus, being an excellent example of the initiatory bulb and the only specimen I have seen of the species (Plate 6, figure 5 *a*). The sculpture, as far as it goes, is that of *Volutilithes*.

As regards the Volutas with a Melonoid nucleus, which is not represented, as far as I can discover, in any stratum older than the Quaternary, it is impossible, in our present ignorance of the biography of the living Volutas, to say whether it is capsular in its development or whether these forms, like *Melo*, are viviparous. They evidently tend toward the type of *Melo*, and it would not be surprising to find the larval progress similar.

As to the recent *Volutidæ*, the invaluable researches of Messrs. Crosse and Fischer have brought together conveniently nearly all that is known, and it would savor of impertinence, in the absence of any substantial addition to our knowledge, if the writer should attempt to travel over the same ground.

Scaphelloid Series.—I have repeatedly referred to the presence of viviparous volutes (*Eucymba*) in the Cretaceous and Eocene. Viviparity or capsular protection would seem to be indispensable for larvæ of these forms with a membranous protoconch. Those forms with small larvæ are capsular and the others viviparous at the present day. The initiation of the capsular or *Caricella*-type is wrapped in obscurity. I have from the lowest Eocene bed immediately covering the Ripley group of Mississippi a perfectly normal, though slender, species (*C. Leana*). In Britain the lowest Eocene affords a similar species (*C. Wetherelli* Sowerby). Thence to the present day the course of development of the Scaphelloid series is uninterrupted and coherent, as my list will show. The Caricellas were badly classed by Conrad in accordance with trivialities of form. A short branch or offshoot, paralleling in the Scaphelloid series *Volutopupa* in the Volutoid series, is afforded by the group of forms in the Paris Basin which have been called *Eopsephæa* by Dr. Fischer. Their surface-characters are intermediate between *Volutilithes* and *Fulgoraria*, and they have the plaits of *Volutilithes*.

Still, a careful scrutiny of the shells leads me to believe that the pointed nucleus is secondary, as in *Caricella* and *Aurinia*.

Subgenus **Caricella** Conrad, 1835.

Plate 6, figs. 9, 11 ; Plate 7, fig. 3.

Types *C.* (*Turbinella*) *prætenuis* and *C.* (*T.*) *pyruloides* Conrad, 1832-3.

This group is varied in form from elongate-fusiform to short and Melonoid ; its surface is smooth or variously sculptured ; the pillar has three or more sharp, clear-cut plaits which vary in their inclination with the coil of the shell ; the suture is usually appressed and rarely lineated ; the outer lip recedes in a marked way to the suture ; the canal is wide ; the outer lip is slightly recurved and simple ; the nucleus shows an elevated point when perfect, and the early whorls have a spirally striate sculpture, sometimes ribbed like *Volutilithes*, without reference to the sculpture or smoothness of the rest of the shell ; the coloration is sometimes preserved, and consisted of dark (red ?), squarish spots in spiral series on a lighter ground, as in the recent *Scaphella junonia*.

I regard *Caricella* as a subgenus of *Scaphella*, as typified by *S. junonia*, the latter name being the earliest. The persistence of the peculiar sculpture on the early whorls and of the pattern of coloration from the beginning of the Tertiary to the present day is a remarkable instance of the preservation of what appear to be very unimportant characters.

In America, *Caricella*, as far as known, is confined to the Eocene and comprises, beside the above-mentioned typical species, *C. doliata*, *prisca*, *demissa*, *pyruloides*, *bolaris*, and *subangulata* Conrad; *C. Heilprini* Dall (*C. Baudoni* Heilprin, Proc. A. N. S. 1880, pl. xx. fig. 15, not of Deshayes), *C. reticulata* Aldrich, *C. Leana* and *C. podagrina* Dall; and abroad *C. Wetherelli* Sowerby, There is one Eocene species, *Voluta Showalteri* of Aldrich, which seems to make a passage to *Scaphella* proper by way of the Miocene *S. solitaria* Conrad, and toward *Aurinia* by way of *Volutifusus typus* Conrad.

Genus **LAPPARIA** Conrad, 1855.

Plate 6, fig. 6.

Type *Mitra dumosa* Conrad, Claiborne sands, 1855 = *Mitra pactilis* Conrad, 1833, and *Voluta dubia* H. C. Lea, 1841.

This Eocene offshoot from the *Scaphella* series is characterized by the *Caricella* nucleus and sculpture of early whorls; by a solid, compact mitriform shell of which the aperture does not exceed half the length of the whole shell; by a short recurved canal with a well-marked siphonal fasciole; four stout subequal plaits, counting that on the edge of the pillar; and by a tendency to nodulation or projecting sharp spires on the shoulder of the whorl. There are three nominal species, the variations of which are such that I expect further study will reduce them all to varieties of one form, under *pactilis*, the oldest specific name. The other names are *Mitra dumosa* Conrad and *Mitra Mooreana* Gabb. Taken together, they extend from the early to the later Eocene, but are not known in the Miocene at present.

These shells are Scaphellas in the larval and adolescent state, and take on mitroid characteristics only near maturity. No true *Mitra* exhibits such a nucleus, and they are beyond a doubt properly referred to the *Volutidæ*, where their peculiar characters entitle them to generic rank. This group probably originated about the same time as *Caricella*, and from the same stock.

Genus **SCAPHELLA** Swainson, 1832.

Plate 7, figure 9.

Scaphella (Swainson) Dall, Blake Gastropoda, Bull Mus. Comp. Zool. xviii. p. 147, 1889.
Type *Scaphella* (*Voluta*) *junonia* Hwass; Florida Strait.

Scaphella as above typified is the descendant in one line, as *Aurinia* is in another, from the Eocene Caricellas. Every character of both can be foreshadowed by that exhibited by some of the Eocene shells. In *C. prisca* we have definitely exhibited the color-pattern alike of *Scaphella junonia* and *Aurinia dubia*. The odd little riblets on the early whorls of *C. prisca* are paralleled in every recent species of *Aurinia*, as is the fine spiral striation. But the plaits are more like those of *Scaphella*; in *Aurinia* they are fewer in number and obsolete toward maturity. The pillar is usually pretty straight in *Caricella*, but in *C. prisca* it is curved. It is, in fact, impossible to frame any diagnosis which shall include the recent and fossil Scaphellas and at the same time exclude *Caricella*. Nevertheless, the latter forms a convenient group from which the typical *Scaphella* is separated, in most cases, by its more fusiform shape, more cancellated early whorls, wider canal anteriorly, and less arched middle outer lip. In the type (recent) of *Scaphella* the nucleus has no elevated point, but the Pliocene forms of the genus make a transition toward *Caricella* in this respect. The plaits of *Scaphella* are flatter and, in harmony with its more fusiform shape, generally more anterior and more oblique.

Scaphella begins in the Eocene with such species as *S. Showalteri* Aldrich, which are intermediate between *Scaphella* and *Aurinia*. This line is taken up in the Miocene by *S. solitaria* Conrad, which has the same color-pattern as *S. junonia*. In the upper (Miocene) bed at Alum Bluff, Fla., occurs the first typical *Scaphella*, *S. Trenholmii* T. & H., followed by *S. floridana* Heilprin, in the American, and *S. Lamberti* Sby., in the European Pliocene, and the well-known *S. junonia* of the existing epoch.

Subgenus **Aurinia** H. & A. Adams, 1853.

Plate 7, figures 2, 4, 5, 7.

Volutifusus Conrad, 1862.
Aurinia Dall, Blake Gastr., Bull. Mus. Comp. Zool. xviii. p. 147, 1889.
Type *Aurinia dubia* Broderip, Florida reefs.

This group is separated from *Caricella* and the typical section of the genus *Scaphella* by the small number and eventual obsolescence of its columellar plaits. It seems also to have lost its radula and jaw, and the recent species offer a parallel in the general senility of several of its characters, compared with its fossil ancestry, with the senile degeneration described by Hyatt in certain Ammonites. The young shell, with sharp plaits and distinct sculpture recalls the Eocene *Caricella* and *Volutocorbis*; the adult, with its nearly smooth surface and obsolete plaits, exemplifies the loss of emphasis commonly associated with old age.

In the Miocene we have *Aurinia mutabilis* Conrad (sp.); *A. virginiana* Conrad (MS.), which is the same as *A. typus* Conrad (which name must be changed, as it is not the type or even typical); *A. dubia* Broderip, *A. obtusa* Emmons (sp.); and an undescribed species with nineteen exceptionally strong ribs on the upper whorls, fine spiral striation and four plaits on the pillar.

A. dubia (Pl. 7, figure 4) may be known by its thin shell, very straight pillar, and two obsolete plaits when adult.

A. mutabilis has a nearly straight pillar, two plaits and a small though characteristic nucleus. It grows larger than *A. dubia*, and is often very like it, but exhibits a perplexing tendency to vary. Conrad's figure of the type shows a series of small riblets at the suture on the upper whorls.

A. obtusa Emmons (Pl. 7, fig. 7) has two plaits and a wide, very large nucleus. It is evidently distinct from the preceding, but is so far only known from young shells.

A. virginiana Conrad. I find this manuscript name of Conrad's applying to his *Volutifusus typus*, an inapplicable name, which is misleading and cannot be retained. It is quite possible that this is the adult of *A. obtusa* Emmons, though we have not yet a connecting series. This species has the aspect of *A. mutabilis*, but has a strongly curved canal, is much smaller when adult, and has the two plaits quite large and strong in what seem to be adult specimens. This feature, if permanent, would conflict with the characteristics of the rest of the group, but more material is needed to decide the question.

The undescribed species is represented by a fragment in the Philadelphia collection, but as it has lost the nucleus and base, it may prove to be a *Scaphella* when a complete specimen is secured.

In the Pliocene *A. dubia* persists, and is also a member of the existing fauna, together with two species not known as fossils, *A. robusta* and *A. Gouldiana* Dall (Pl. 7, figs. 2, 5), on the southeastern coast of the United States.

The fragment upon which Conrad founded his *Megaptygma sinuosa* has a general resemblance to *Scaphella Trenholmii*, but shows a much more curved base and three, or possibly four, plaits. These have the aspect of being diseased, and their characters may eventually prove pathologic. There is no doubt, whatever it is, that it ranges somewhere in the Scaphelloid series.

There is some reason for thinking that the genus *Halia* Risso, Pliocene and recent in European waters, may be the last term of degeneration in this direction, having lost all its plaits and holding much such a relation to *Aurinia* as does *Guivillea* of Watson, also a deep-water and degenerate type. *Provocator* Watson should, from its published characters, belong in this vicinity; its posterior sinus, as in *Harpa*, is not homologous with that of *Pleurotoma*, but simply allowed the passage of a fold of the mantle by which the glaze covering the spire was deposited, much as in *Liopeplum*.

Genus **CYMBA** Broderip & Sowerby, 1826.

Type *Cymba* (*Voluta*) *olla* Linné, European seas.

This group is distinguished by its viviparous habit, its superficial glaze, its animal too large to fully enter the shell, its spire uncrowned by a row of spires, and its mammiform, enormous secondary nucleus. The pillar is twisted, the shell thin, elongate and rather narrow (compared with *Melo*), the suture, or the whorl near it, usually channelled or turrited, and the spire nearly involute.

The synonymy is confused and I shall not attempt an exhibit of it here, but I believe the name of *Cymba* to be entitled to acceptance.

It is known only in the later Tertiary beds and has never been an inhabitant of North America or the adjacent seas.

Subgenus **Eucymba** Dall.

Plate 7, figure 1.

Type *E. ocalana* Dall, Upper Eocene of Florida.

Shell shaped like *Fulgur* when young, with a slender, long canal and fig-shaped body, the adult subglobular, large; nucleus lenticular, large, laterally bent, secondary; axis straight with four sharp, elevated plaits; shell thin, unsculptured, without superimposed glaze; spire short, the early whorls spirally striate; outer lip simple, thin, arched forward toward the middle, receding somewhat at the suture, which is distinct, but not channelled.

This group is nearly related to *Caricella* and seems to have preceded it, as there are several Cretaceous species, notably *Voluta deperdita* Goldfuss, which should probably be referred to it. It is sufficiently distinguished from *Cymba* proper, which may be descended from *Eucymba*, though this is not yet definitely established.

This completes the review of the group comprising the American fossil *Volutidæ*. I have made no attempt to investigate the family as a whole for want of satisfactory material and time, but believe that when a thorough review of the whole family is attempted, the suggestions of the present sketch may prove of importance.

It now remains to enumerate and describe the species connected with the present investigation, with which I shall include a few which are necessary for illustration, but which do not form part of our Florida collection.

Liopeplum Spillmani Dall.

Plate 6, figure 12.

? *Voluta Spillmani* Tuomey, Proc. Acad. Nat. Sci. Phila. vii. p. 169, 1855. Cretaceous of Alabama.

Shell small, rather thick, with the spire shorter than the aperture and the whole surface covered with a thin and brilliant glaze; nucleus minute, "trochoid," in the adult obscured by glaze; subsequent whorls five, constricted in front of the closely appressed suture; spiral sculpture, on the early whorls, of narrow, shallow, close-set grooves, strongest behind the periphery, on the last whorl obsolete, except near the canal; transverse sculpture, beside incremental lines, comprised, on the early whorls, of 15–20 close-set, small, distinct riblets, strongest on the periphery and gradually becoming obsolete about the third whorl; these riblets are rounded and cross the whorl without flexure nearly at right angles; beside the general thin coat of glaze which covers the whole shell, there is a special deposit on the periphery, growing thicker as the whorls increase, but more rounded and less prominent than in *L. liodcrma;* the last whorl has its greatest diameter in front of the fasciole near the suture and gradually tapers thence anteriorly; the aperture is narrow and long; the canal not constricted, but rather deeply sulcate, making a well-marked siphonal fasciole. Outer lip simple, smooth inside, receding near the suture and toward the canal; pillar nearly straight, with a thin wash of callus, perhaps more prominent after maturity, with two distinct but feeble plaits, which are partly obscured by callus; near the posterior sinus of the aperture is a large mass of glaze which on the last whorl is deposited a little below, but in the others upon, the periphery. Lon. of shell 41.0; of aperture 25.0; max. lat. of shell 17.0 mm.

The specimen figured comes from the Ripley sands at the summit of the Cretaceous formation in Tippah Co., Mississippi.

This is an extremely elegant shell, notable for its brilliant surface. I feel little doubt that it is identical with Tuomey's imperfectly described and unfigured species of 1855. In the figure the spiral lines of the early whorls and on the pillar are less prominent than they are on the shell, being perfectly visible through the glaze on the specimen, but too much covered to affect the sculpture of the surface. I am indebted for specimens for study and figuring to Dr. C. A. White, in charge of the Division of Mesozoic Paleontology of the U. S. Geological Survey.

Liopeplum subjugosum Dall.

Plate 6, figure 12 a.

? *Voluta jugosa* Tuomey, Proc. Acad. Nat. Sci. Phila. vii. p. 169, 1855; not of Sowerby.

Voluta subjugosa Gabb, Proc. Acad. Nat. Sci. Phila. for 1861, p. 149. Cretaceous of Alabama.

Shell thick, brilliantly glazed with five (or more) whorls; nucleus small, whorls turrited; spiral sculpture of a few weak threads on the foremost part of the shell on and near the siphonal fasciole and mostly buried in callus; transverse sculpture of (on the last whorl) fourteen or fifteen rounded, thick, strong waves, beginning at the shoulder, which they coronate, and extending about one-third of the way forward with equal or narrower interspaces; these ribs or waves cease quite suddenly, and on the preceding whorls their anterior terminations are covered by a spiral elevated ridge of callus, which overshadows the obscure suture from which it is separated by a narrow space, thus forming between the ribbed shoulder of one whorl and the spiral callus of the other a deep channel; aperture long and narrow, the canal not constricted; outer lip simple, nearly straight in the middle, receding deeply between the suture and the shoulder, thus making a sinus for the glaze-secreting process of the mantle; pillar concave in the middle, a little twisted, with a strong siphonal fasciole upon which in the adult is a thick mass of callus on the anterior half, on which ride one weaker posterior and three strong anterior plaits, behind which on the body of the whorl there is only a thin layer of callus. Approximate dimensions of adult: Lon. 45.0; lon. of aperture 28.0; max. diam. 16.0 mm.

Ripley sands of Tippah Co., Miss., Mr. Stanton.

These specimens, being very soft, are mostly crushed or broken, but the characters can be made out and the remarkable and elegant sculpture cannot be mistaken. The brilliancy and lustre of the glaze would make this shell, if perfect, one of the most beautiful and attractive of our fossils. The specimen figured had the sculpture of the back best preserved, but this and other treasures of the Ripley sands will doubtless be fully illustrated by Dr. C. A. White in his promised study of that fauna.

Volutilithes precursor Dall.

Plate 6, figure 1.

Shell subfusiform, six-whorled; nucleus small, spiral sculpture of the usual threads near the canal anteriorly, fading away toward the periphery and appearing again on and behind the shoulder; transverse sculpture of twelve or more rather rounded, not much elevated ribs, which, on the last whorl of the adult, are a little sharper by having a long anterior and a short posterior slope, which gives them a sort of flattened appearance; they pass clear over the shell and are sharpest at the periphery, while in most species of this group in American rocks the ribs are most prominent on the shoulder and become obsolete on the body; suture appressed, the whorl in front a little constricted, with a tendency to small, prickly points at the shoulder; aperture narrow, outer lip simple, thickened at the ribs, but not varicose, strongly lirate within; inner lip with a wash of callus anteriorly and two well-marked, subequal, clear-cut, distant plaits; canal a little constricted, nearly straight, deeply notched, forming a fasciole. Max. lon. of shell 28.0; of aperture 20.0; max. diam. 13.0 mm. A fragment indicates a length of aperture sometimes attained of 34.0 mm., corresponding to a shell 47.6 mm. in length.

The specimens are of Eocene age, the locality half a mile east from Wheelock, Texas.

This shell has been figured as showing the tendency toward the surface-characters of *Lyria* and the slight conchological gap separating these forms. Its nearest relative is *V. rugatus* Conrad, which is found in the same stratum, and from which its sculpture distinguishes it with sufficient clearness. It will be observed that the plaits are not crowded by callus, as is commonly the case in this genus, and I may add that, in one specimen, a feeble third plait lags behind the others within the shell.

Lyria pulchella Sowerby.

Plate 4, figure 3.

Voluta pulchella Sby., Quart. Journ. Geol. Soc. Lond. vi. p. 46, pl. ix. fig. 4, 1850.

Miocene of Santo Domingo and of the silex-beds at Ballast Point, Tampa Bay, Florida.

I obtained a single young specimen, distinctly of Sowerby's species, near Ballast Point. I regard it as quite distinct from the following species, if the specimens observed have normal characters.

Lyria zebra Heilprin.

Voluta (*Lyria*) *zebra* Heilprin, Trans. Wagner Inst. i. p. 110, pl. 15, fig. 46, 1887. Not

Voluta zebra Leach, Zool. Misc. i. pl. 12, fig. 1, 1814; Sowerby, Thes. Conch. i. p. 195, pl. 53, figs. 83, 84, 1847.

Ballast Point silex-beds, Willcox, Burns and others.

The young of this species run very close to *L. harpula* Lam., but the adults are quite distinct.

Lyria musicina Heilprin.

Voluta musicina Heilprin, Trans. Wagner Inst., vol. i. p. 109, pl. 15, fig. 45, 1887.

Upper Eocene at Richards' quarry, Ocala, Florida, Willcox; Lower Miocene of Chipola River, West Florida, near Bailey's Ferry, corresponding to the lower stratum at Alum Bluff, and also at the silex-beds, Ballast Point, Tampa, by Messrs. Burns, Willcox, Shepard and others.

This species has the thickened and reflected lip and small, though sometimes inflated, nucleus of *Lyria*. No differences can be detected between the Ocala, Tampa, and Chipola specimens. It grows to a large size : one of my specimens measures 62.0 mm. long by 30.0 mm. in maximum diameter. It has six strong and five accessory plaits, generally, though the number is not absolutely constant.

Lyria costata Sowerby.

Plate 6, figure 2.

Voluta costata (Brander) Sowerby, Min. Conch. iii. 163, pl. ccxc. figs. 1, 2, 4, 1821.
Voluta sp. Lesueur, Walnut Hills Foss., pl. 4, fig. 13, 1829.
Fulgoraria mississippiensis Conrad, Journ. Acad. Nat. Sci. Phila. i. 2d ser. p. 119, pl. 13, fig. 1 (bad !), Aug., 1848.
Otocheilus mississippiensis Conrad, Am. Journ. Conch. i. p. 24, 1865.

Upper Eocene of Vicksburg beds at Vicksburg, Miss., also in the Red Bluff horizon of about the same age at Carson's Creek, Wayne Co., Alabama, and at Walnut Hills, Miss. (Lesueur). Eocene of Britain.

The genus *Otocheilus* Conrad was never described. It is absolutely synonymous with *Lyria*. This species, and an unfigured and unidentifiable *O. nereidis* Conrad, were the types; the latter was the second species. The figures given by Sowerby are bad, his description is applicable only to the immature shell. Conrad's figure is also uncharacteristic. From study of authentic specimens from both sides of the Atlantic, I am prepared to say that they are specifically identical and have not even varietal differences. I have figured it, partly for comparison with the *Volutilithes* previously mentioned, and partly in order that its true characters may be understood. It is the precursor of the Miocene *L. musicina* Heilp. The specimen figured is 32.0 mm. in length.

The Red Bluff specimens are a little rounder in the ribs, and the early whorls are straighter-sided than in those from Vicksburg. But these differences are not specific. It is curious that original specimens from Conrad and an English one received from J. Sowerby by Dr. Lea are more exactly similar than American specimens from different localities are to each other. The differences shown by suites of specimens of recent Lyrias and by *Voluta musica* give us a suitable idea of how much stress should be laid on these trifling mutations in the fossil specimens. It is not enough to have a large suite from one locality. A series from a wide geographical range can alone give a clue to the range of specific variation.

Scaphella (Caricella) Leana Dall.

Plate 6, figure 9.

Shell small, elongate-fusiform, of five or six whorls; nucleus small, with a distinct spur or elevated point (which formation may conveniently be termed the *calcarella*) and composed of one whorl; suture closely appressed, the whorl somewhat constricted in front of it; the whole shell sculptured with small, subequal, close-set, flattish spiral threads, across which the incremental lines are hardly perceptible; aperture longer than the spire, narrow, with a faint recession at the suture (not well shown in the figure, which is too straight at this point) and a long, narrow, straight canal; pillar with no siphonal fasciole, a thin glaze anteriorly, and four thin, sharp, well-elevated plaits, of which the anterior is the least pronounced; canal not constricted off; outer lip simple. Lon. of shell 26.0; of aperture 18.0; max. lat. of shell 8.0 mm.

Lower Lignitic series, Prairie Creek, Wilcox Co., Alabama, in the clays (No. 5) just above the Nautilus rock or *Enclimatoceras* limestone.

This is the earliest and smallest and one of the neatest species of the *Caricella* group so far known. It resembles in miniature the Miocene *Scaphella Trenholmii* and has entirely shaken off any characteristics of *Volutilithes*, if it ever had ancestors of that type. The contrast between such a species as this and the capacious, heavy forms like *Caricella subangulata*, which appeared later on, is very marked; but in the decline of the group the last (Oligocene) species of *Caricella*, *C. demissa* Conrad, returns to very much such a form as this first species exhibits.

The *Nautilus* rock is the first fossiliferous Eocene bed, and lies immediately over the Cretaceous Ripley beds. It contains, beside the *Nautilus Ulrichi* White, a number of gigantic *Cerithia* like those of the Paris basin, which have not hitherto been recognized, but have been referred to *Chemnitzia* (Conrad) and *Turritella*, partly, no doubt, on account of their inferior state of preservation.

Caricella podagrina Dall.

Before examining the type of *C. subangulata* as figured by Wailes and named by Conrad, I had supposed the present shell to be *subangulata*, and the true *subangulata* to be undescribed, and in this way it comes that the latter is figured, and the present species not so. The differences, however, are few and easily pointed out. *C. podagrina* differs from *C. pyruloides*, and especially from *C. subangulata* (under which name I have received it from Mr. Aldrich), by its much more sunken spire, the tops of the whorls being flat or excavated; by the last whorl with a marked but not sharp angulation at the shoulder, and wider anteriorly; and by the sutural edge of the last whorl, which is elevated and rounded, dropping suddenly to the suture instead of being smoothly appressed against it. Wailes' figure does not show the suture of *subangulata* accurately. *C. podagrina* is also larger, much more solid and heavy, with a less polished surface, and belongs to a much earlier geological horizon.

The nucleus is large and blunt, followed by about four whorls, which are spirally striated and show well-marked incremental lines. Between the angle and the sutural sinus, which last is emphasized, the lip is somewhat concave. In front of the angle it is nearly straight. There are four strong columellar plaits. There are no traces of color on the outside of the shell, but the middle layer of the shell, when exposed by erosion, is of a very dark color, when well preserved. In full-grown specimens there is a rather thick callus on the body-whorl. The species reaches a size of 90 x 70 mm. The plaits are rather thicker and closer together than in *C. subangulata* of the same size.

Specimens have been received only from the Upper Lignitic group of the Alabama Eocene, considerably below the Claibornian, and were collected at Bell's and Gregg's Landings, Alabama.

Scaphella (Caricella) subangulata Conrad.

Plate 6, figure 11.

Caricella subangulata Conrad, Wailes' Geol. Miss., p. 289, pl. xv. fig. 8, 1854. Proc. Acad. Nat. Sci. vii. p. 257, 1855.

Shell rather large, thick, short-spired, pyriform, with five or six whorls; nucleus of the subgenus; early whorls after the nucleus exhibiting the usual spiral striation, which becomes obsolete; suture very closely and firmly appressed, leaving the suture almost obscure; spire short-conic, the whorls slightly swelling, the last much the largest, short, widest posteriorly, evenly rounded over the periphery, rapidly attenuating to a short, pointed and somewhat recurved canal; aperture wide behind, narrow in front; outer lip in the adult simple, sharp, receding deeply to the suture, with a strong callus at the commissure; the lip projects forward at the widest part of the shell and recedes again to the canal, but much less suddenly; inner lip moderately callous, with four high, strong, subequal plaits, grooved behind, with the anterior plait the weakest; canal short, slightly constricted and recurved, with a perceptible fasciole, striated spirally on the back, the middle part of the whorl smooth or marked only by fine incremental striæ. Max. lon. of shell 57.0; of aperture 47.0; max. diam. 42.0 mm.

Collected at Moody's Branch, near Jackson, Miss., and four and a half miles east of Shubuta, Miss., in the Upper Eocene or "Jackson" group of strata. Also from "Creole Bluff," Louisiana.

This form is related to *S. Heilprini* and to *S. podagrina* Dall of the Upper Lignitic horizon, and still more closely to *C. pyruloides* Conrad, of which it may prove only a specially exuberant variety. Conrad's figure represents the suture with a ridge before it instead of closely and smoothly appressed as the type-specimen shows it to be. But the figures in Wailes' Report are none of them very exact. This species does not attain more than three-fifths the size of *S. podagrina*, and young ones graduate almost imperceptibly into *S. pyruloides*, which in general is more ovate, smaller and much thinner and lighter than *S. subangulata.*

C. podagrina belongs to the Bell's and Gregg's Landing beds, or Upper Lignitic, instead of the Jackson beds, with which *C. subangulata* is associated.

C. Heilprini is much more elevated and, if correctly figured, has the plaits crowded together and more or less connected by callus. This feature I suspect to be due to the draughtsman, as it would be unique in the group. It would be a very much thinner shell than *C. podagrina* or *C. subangulata* and more sharply fusiform before and behind. I may add that the *Voluta Bandoni* of Deshayes, to which this species was referred in 1880 by Prof. Heilprin, is not likely to be a *Caricella* or nearly related to the present species.

C. pyruloides Conrad, of which *C. polita* Conrad is an elongated variety, is the nearest relative of *C. subangulata*, from which it is distinguished by its thinner and generally smaller shell, more oval form, narrower aperture, more widely separated and delicate plaits, straighter and more pointed canal. In brief, *C. pyruloides* is more delicate, elongated and less top-shaped.

Scaphella Trenholmii Tuomey & Holmes.

Plate 6, figure 10.

Voluta Trenholmii T. & H., Plioc. Foss. S. Car., p. 128, pl. 27, figs. 7, 8, 1856.

Miocene of Maryland, South Carolina and Florida; in the Upper bed at Alum Bluff on the Chattahoochee River, West Florida.

The fragment here figured was at first supposed to be new, but the discovery of more material and a comparison with specimens in other collections and at Philadelphia enable me to determine its proper place. This species is undoubtedly Miocene in South Carolina, being one of those Miocene species confounded with the Pliocene fauna in the magnificent work of Tuomey & Holmes. The specimen figured is quite immature.

Scaphella (Aurinia?) striata Gabb.

Scapha striata Gabb, Geol. San. Dom., p. 219, 1873.

Miocene of Santo Domingo. Type in the collection of the Academy of Natural Sciences, Philadelphia.

This is a good species of the *Aurinia* group in everything except the plaits, which appear to continue strong instead of fading away as in *Aurinia.* There are only two, as in *Aurinia*, and this species by its characters adds one more link to the connection between the Miocene of Santo Domingo and the United States, very similar forms—*S.* (*Aurinia ?*) *typus* and *virginiana* Conrad—occurring in our Atlantic Miocene. The types of *striata* are not full-grown, and may present the characteristics of *Aurinia* when adult.

Scaphella floridana Heilprin.

Plate 7, figure 8.

Voluta floridana Heilprin, Trans. Wagner Inst. i. p. 77, fig. 8, 1887.

Pliocene of the Caloosahatchie beds, Messrs. Willcox, Heilprin, Dall, etc.

This fine species differs from *Scaphella junonia* by its greater size and more acute spire, and from the *S. Trenholmii* of the South Carolina Miocene by more fusiform shape and prominently cancellated early whorls. The number of plaits and the pattern of coloration, which is occasionally preserved, are the same. These differences were pointed out in his original description by Prof. Heilprin.

It is to be remembered, however, that *S. junonia* is still very rare, and usually has been polished or mutilated by the dealers, and that no sufficient series of *S. Trenholmii* has ever been brought together; a larger series might efface the discriminating characters referred to and lead us to regard the three forms as varieties of the same stock in process of development in geological time. The differences, though intensified, are those which I have found existing to a certain extent in the seven or eight specimens of *S. junonia* which I have been able to bring together for study.

Eucymba ocalana Dall.

Plate 7, figure 1.

Adult shell short and broad, subglobose, with a short and rather wide canal; nucleus low and wide, with an obscure eminence at the summit, the external surface slightly amorphous, and the whole nucleus inclined to one side; early whorls finely, evenly, spirally striate, as in *Caricella;* later ones with occasional faint spiral markings, otherwise smooth except for lines of growth; suture closely appressed at first, later the outer margin slightly rounded; spire obtuse, with a short and gentle slope, rounded at the shoulder and gradually diminishing toward the base; in the young (see figure 1.) the canal is long, narrow and shallow; in the adult it is proportionately much shorter and wider; shell thin, except the pillar, which is straight and strong, bearing four subequal oblique plaits, the posterior of which lags a little behind the others; there are no internal liræ, nor any indications that the lip was otherwise than simple; it recedes a little from the shoulder to the suture, but does not form a notch, in front of the shoulder it falls away to the canal almost as in *Caricella.* There is but a slight wash of glaze on the body inside the aperture and none outside; the callus on the pillar is also rather thin for so large a shell; there is no siphonal fasciole.

An internal cast of an adult measures 100.0 mm. in length, though the canal is not entirely complete. The max. diam. of the same is 83.0 mm. The specimen had four whorls beside the nucleus, which contains 1½ to 2 whorls. The young specimen figured measured 48.5 x 21 mm. The max. diam. of the nucleus, in a crushed specimen which retains the shell, is 11.0 mm.

This species was found by the U. S. Geological Survey in the Mid-Eocene of the Wahtubbee Hills, four and a half miles west of Enterprise, Mississippi, and by Mr. Joseph Willcox in the limestone quarry of Mr. Richards at Ocala, Florida, associated with *Nummulites Willcoxii* Heilpr. and other Upper Eocene fossils.

Voluta? sp. indet.

Plate 6, figure 5a.

Four and a half miles S. W. from Enterprise, Miss.

This tip, which is all we have of the species, is figured to show an Eocene example of the bulbous nucleus. The sculpture of the succeeding shell, so far as it remains, is like that of *Volutilithes*, but so is that of the early whorls of most sections of the *Volutidæ* of the earlier Tertiaries. If it is the tip of a *Lyria*, the species has a more swollen nucleus than any *Lyria* I have been able to examine. The pillar has a single plait and slight traces of a second one. The age of the beds is too great for a typical *Voluta*, it cannot be a *Volutilithes*, and altogether this fragment presents a pretty puzzle for some future paleontologist to unravel. The length of the specimen is 10 mm.

Genus **PERPLICARIA** Dall.

Shell ovate-fusiform, cancellated; nucleus smooth, involute, small; outer lip thickened; pillar thin, twisted, with a single high, sharp plait parallel with it throughout its length.

This singular shell has a small, smooth nucleus, with the tip infolded. Its general aspect would recall *Daphnella*, having much the same cancellated surface and obliquely coiled whorls. There is no sutural sinus, and the pillar is unlike that of any shell known to me. The unfortunate fact that the unique specimen is defective anteriorly prevents any confidence in one's opinion of its relations. They may be with the present family, but I incline rather to the supposition that the shell is related to *Fasciolaria* or *Ptychatractus*. The surface, however, recalls *Volutocorbis* more emphatically than any other form, unless it be *Volutomorpha*. I leave the genus between the volutes and *Fasciolaria* pending further information.

Perplicaria perplexa n. s.

Plate 3, figure 1.

Shell small, five-whorled; nucleus smooth, of a whorl and a half, rapidly increasing, the tip involute; sculpture cancellate, composed of numerous strong, even, transverse costæ, with narrower interspaces crossed by (on the whorl before the last) about seven strong and an equal number of finer intercalary threads which descend into the interspaces and override the costæ without nodulation at the intersections; the base has similar sculpture, but the costæ become obsolete as they advance toward the canal; the suture is distinct, but not channelled; there is no presutural band or sinus; the aperture is rather long and narrow; the outer lip is slightly thickened, but hardly reflected; behind it there seems to be a sort of varix made by a slight thickening of the shell; the outer lip is internally lirate for a short distance near its edge; the canal is shallow and not constricted, it forms no fasciole; inner lip with a slight glaze. Lon. of the specimen figured 13.0; max. diam. 4.5 mm.

Pliocene of the Caloosahatchie beds, collected by the writer.

The specimen has lost the whole of the last whorl except a small triangular piece of the outer lip near the suture. It is probable that the figure represents a longer canal than would have been present if the last whorl had never been formed, judging by the lines of growth on the remaining basal part of the penultimate whorl.

FAMILY MITRIDÆ.

Genus **MITRA** Lamarck.

Mitra lineolata Heilprin.

Mitra lineolata Heilprin, Trans. Wagner Inst. I. pp. 79, 133, 1887; not of Bellardi, 1887.

Caloosahatchie beds on the Caloosahatchie River and Shell Creek, Florida. Pliocene of South Carolina, one mile east from Darlington Court House, South Carolina.

After the examination of a large series, I have come to the conclusion that Prof. Heilprin's species is distinct from *M. carolinensis* Conrad, though that species, which is chiefly Miocene in distribution, is closely related to it. A comparison of the young shows more marked differences than are at first apparent in the adult. In *carolinensis*, about 30 mm. long, the whorls are more distinct, the spiral sculpture rounder and the spirals more numerous, the interspaces are more channelled or flat-bottomed, while in *lineolata* it is rounded concave as if scooped out with a gouge and the spirals are sharp-edged. There are three spirals between the sutures in *lineolata* and four in *carolinensis*. The former is also slightly more inflated in the last whorl. In the adults the body of the whorl is usually encircled by five or six fine, distant, sharp threads in *lineolata* and the pillar is almost perfectly straight; in *carolinensis* the periphery is usually destitute of sharp threads and the pillar is somewhat twisted, showing a well-marked fasciole.

The specimen figured by Tuomey & Holmes as *carolinensis* appears not to belong to *lineolata*, but we have undoubted *lineolata* collected by Mr. Frank Burns, of the U. S. Geol. Survey, near Darlington, South Carolina. Specimens reach 100.0 mm. in length.

M. carolinensis belongs to an older horizon and does not attain so great a size as *M. lineolata:* the maximum is about 70.0 mm. It is not rare in the Lower Miocene of N. W. Florida, near the Chipola River, and in the Miocene marls of North Carolina.

M. carolinensis is the type of Conrad's genus *Pleioptygma*, which he referred to the *Volutidæ*, but which there is no ground, in my opinion, for separating from *Mitra*. The nucleus is small, shelly, polished and few-whorled.

While I have no doubt in my own mind that *Voluta*, *Scaphella*, *Turbinella*, *Fasciolaria*, *Mitra* and the *Fusidæ* all proceeded from one stock and could not be separated as families in the Eocene time, yet that does not exclude the recognition of the divergencies which have been brought about at the present epoch, by gradual evolution, from more compact original groups.

I do not know which of the two species named *Mitra lineolata* in 1887, was published first, but, judging by the figures, Bellardi's species have but a feeble systematic value, and in some cases hardly rise above the rank of individual mutations.

Mitra wandoensis Holmes.

Volutomitra wandoensis Holmes, Post-Plioc. Foss. S. Car., p. 77, pl. x. figs. 10, 10 a, 1860.

? *Pyramidella reticulata* (sic) Emmons, Rep. N. Car. Geol. Sur., p. 268, fig. 155, 1858.

? *Mitra Rushii* Dall, Conch. Exchange, vol. ii. p. 9, 1887. Report on Blake Gastr. Mus. C. Z., Bull. vol. xviii. p. 160, 1889.

Post-Pliocene marls of Wando River, South Carolina, Dr. Ravenel. Caloosahatchie beds. ? Miocene, North Carolina, Emmons.

The figure given by Holmes is very woolly and not sufficient by itself to identify the species. The specimen on which it was founded is in the American Museum of Natural History, New York. It appears to be considerably worn and shows two evident plaits on the columella and the suspicion of a third plait. The recent shell, collected by Dr. Rush and also by the U. S. Fish Commission and named by me *Mitra Rushii*, would appear to be the perfect state of a very similar, if not identical, species. The recent shell is of a fine dark reddish brown, with about thirty narrow, smooth, concavely arched, close-set ribs, extending well over the whorl. Between them are visible numerous equal, rounded spiral threads with nearly equal interspaces. The threads are only visible between the ribs, and the short, deep interspaces, thus reticulated, when the ribs are worn, appear like punctures. The canal is short, with four or five strong spiral grooves externally, the anterior grooves deepest. There are three plaits. The nucleus is large, rather inflated, smooth and brilliantly polished. The suture is distinct, but not strongly emphasized.

I have but one specimen from the Caloosahatchie beds, but it is abundant in the recent state from the vicinity of Cape Hatteras, southward to the Gulf of Mexico, in from 12 to 60 fathoms, gravelly bottom. There is little doubt that Emmons' figure and description were intended for this species, but the specific name *reticulata* was already preoccupied in this genus.

Mitra Holmesii n. s.

Plate 3, figure 11.

Shell small, resembling *M. wandoensis* Holmes, in a general way, but differing from that species in its more slender whorls and flattened sides, in having 16–18 transverse, nearly straight ribs, instead of 28–30 curved ones; in its wider interspaces between the ribs crossed by rounded, coarser, equal spirals, whose interspaces are not channelled and never look punctate; the ribs are also more shouldered than in Holmes's species, so that the suture of *M. Holmesii* is more marked. Max. lon. of shell 4.1; max. lat. 1.6 mm., in a shell of six whorls. The columella is plicated by three folds, the posterior the largest.

Caloosahatchie beds, rather numerous.

This species is somewhat like *M. Partschii* Hoernes from the Vienna Basin, but sufficiently distinct.

Mitra sp. indet.

A single specimen too worn to name was found in Caloosahatchie marl. It has about sixteen ribs and in general resembles a slender *M. wandoensis*, but just below the periphery of the whorl is a marked groove, channelled and cutting the ribs as well as the interspaces. On the earlier whorls this channel revolves a short distance behind the suture, which thus appears double. This character will enable the species to be recognized when perfect specimens are found. There are three folds on the columella and the shell is about the size of the next species.

Mitra Willcoxii n. s.

Plate 3, figure 10.

Shell of about seven whorls, with sculpture of much the same character as that of *M. Holmesii*; but on the last whorl the transverse sculpture becomes more or less obsolete, differing in different specimens in this respect. On the one figured there would have been twenty-six transverse ribs, but each alternate rib is obsolete, while the others are bulbous at the suture and obsolete on most of the periphery. The spiral sculpture is represented by grooves, squarely channelled and broken into square pits by the foundations of the obsolete ribs which interrupt the spirals. There are about ten spirals on the last whorl, and three or four very strong distant cords on the canal; aperture narrow, columella short, three-plaited; suture distinct, not channelled; nucleus smooth, polished, rather large, as in *M. wandoensis* and *M. Holmesii*. Max. lon. of shell 8.3; max. lat. 2.8; lon. of aperture 3.8 mm.

Caloosahatchie marl, not rare.

This neat little species is quite variable, but in all the specimens I have seen the ribs in the adult are more or less obsolete. The square pits recall *M. wandoensis*; the general sculpture of the young shell is more like *M. Holmesii*, which, when adult, is about half the size of this species.

Mitra (**mississippiensis** var.?) **silicata** Dall.

Plate 4, figure 11.

This shell recalls *M. mississippiensis* as described by Conrad, from which it differs by having one more plait on the columella, and by the appressed suture. The pseudomorph in this case is imperfect, and probably the shell was worn before it was fossilized, so that the absence of the transverse striation, called for by the diagnosis of *mississippiensis* and absent on our fossil, is not significant.

Our shell is elegantly fusiform, slender, with gently rounded whorls, appressed suture and faint incremental lines, or none; sculpture of sharp-edged, revolving ridges, four between the sutures, and on the last whorl an intercalary smaller thread; there are fourteen or fifteen nearly uniform primary ridges on the last whorl. Lon. of last whorl 23.2; of aperture 17.0; max. lat. of whorl 9.5 mm.

Tampa silex-beds, between Ballast Point and the town; Mr. Shepard.

This shell is related to such species as *M. striatula* Lamarck, by its sculpture, and still more to such species as *M. pia* Dohrn and *M. Hindsii* Reeve, of West America. I doubt its pertinence to *M. mississippiensis* Conrad, but the differences may be due to age, wear and imperfection of the specimen.

This species and those which precede it, except *M. carolinensis*, would have been included in Conrad's genus *Fusimitra*, of which *M. cellulifera* Conrad was the first species. But this genus never had any value, and Conrad's original list contained the precursors of species as different as *M. wandoensis* and *M. Swainsoni* Brod.

There are several closely allied forms in the Eocene, one of which almost unchanged has come down to us living in the deep water of the Gulf of Mexico.

Mitra conquisita Conrad, is a common species of the Upper Eocene with which a shell named and figured from the Jackson beds by Conrad in Wailes' Geology of Mississippi as *M. Millingtoni* (but never described) was afterward confused by Conrad himself. The former is a much smaller and proportionally stouter shell. *M. Millingtoni* is found up to 130 mm. in length, and is the precursor of *M. Swainsoni* Broderip (West America) and the form which in my report on the Blake Gastropods I have called *M. Swainsoni* var. *Antillensis*. From the latter the fossil is not separated by any specific characters of serious importance. Internal casts of it were found in the soft limestones at Ocala.

Gabb's Miocene *Mitra Titan* from Santo Domingo appears to be almost identical with *M. Millingtoni*.

Subgenus **Conomitra** Conrad.

Conomitra staminea Conrad.

Plate 4, figure 2.

Mitra staminea Conrad, Journ. Acad. Nat. Sci. 2, vol. i. p. 120, pl. 12, fig. 4, Aug. 1848.

M. vicksburgensis Conrad, *op. cit.* p. 120.

Conomitra angulata Heilprin, Trans. Wagner Inst. i. p. 110, pl. 15, fig. 47, 1887.

Upper Eocene at Vicksburg, Miss.; Lower Miocene at Ballast Point, Tampa Bay, at Six-Mile Run, near Orient Station, N. E. from Tampa, and at the Chipola River in N. W. Florida. Also in the Orbitolitic rock overlying the silex-beds about Tampa.

The Claiborne species *C. fusoides* Lea is distinguishable from the Vicksburg form by its shorter and plumper form, smaller average size and the impressed line in front of the suture. All the species I have seen from the silex-beds are of one species, which is proportionally longer and smoother when adult than in youth. The recent species *C. Blakeana* Dall is closely related to it, but is still smoother and with shorter spire. Both the recent and the fossil forms are very variable in form and sculpture, but they represent without doubt the successive terms of an hereditary series. The specimen figured is a siliceous pseudomorph from Ballast Point which does not show the spiral lines, but their traces can be perceived under a glass, and on some other specimens they are conspicuous. Specimens reach 17.5 mm. in length.

Genus **MITROMORPHA** Adams.

Mitromorpha cincta n. s.

Plate 3, figure 6.

Caloosahatchie beds, on the Caloosahatchie River, rare.

Shell small, six-whorled, subfusiform, with a blunt, smooth nucleus; transverse sculpture only of faint incremental lines; spiral sculpture of prominent keels with wider interspaces, about four keels appearing between the inconspicuous sutures; whorls rather flattish, the periphery of the last whorl subangulate in the young; mouth narrow, more than half the length of the shell; outer lip crenulated by the sculpture when thin, simple in the adult; inner lip nearly straight, with a very obscure ridge on the middle of the pillar, deep in the throat in the adult. Lon. of shell 7.25 ; max. lat. 3.0 mm.

This plain and simple little species is more slender and has more distant spirals than the recent *M. dormitor* Sby., there are no granulations on the spirals nor the prominent nodules on the pillar such as characterize the recent *M. biplicata* Dall.

The ridge on the pillar is not prominent enough for a plait, but rather like an extra deposit of callus.

Mitromorpha pygmæa Dall.

Plate 10, figure 3.

Shell small, fusiform, with five whorls, of which one and a half are nuclear; nucleus smooth, polished, rapidly enlarging, the initiatory part being quite small; spiral sculpture of strong, squarish threads, with wider, channelled interspaces; there are four threads between the sutures; transverse sculpture of obscure incremental lines and on the upper whorls of 12–14 rounded ribs, strongest anteriorly, overridden by the anterior threads, but ceasing in front of the posterior thread, by which the suture is made conspicuous; whorls slightly rounded; aperture about half the length of the shell, narrow, pointed behind, wider in front; outer lip simple, inner lip hardly glazed; pillar straight, with two small, oblique pustules about the middle, the posterior the larger of the two. Lon. of shell 4.0; max. lat. 1.5 mm.

This minute and very pretty species was found by me in the Caloosahatchie marl. Only two specimens were found. It appears quite distinct from any described species. When fully adult this and the preceding species, like the recent ones, probably have the outer lip a little thickened and even minutely denticulated on its inner edges. Even in the recent species it is rare to find specimens having full marks of maturity, so it is not safe to infer from their absence in a few specimens that they are always absent.

FAMILY TURBINELLIDÆ.

Genus **TURBINELLA** Lamarck.

The earliest species yet recorded, though doubtless not the earliest to appear in the New World, is *Turbinella Wilsoni* of Conrad, from the Vicksburg or Upper Eocene horizon of Mississippi. This species was marked by a small nucleus and many-whorled, acute spire. In the Lower Miocene appeared *T. polygonata* Heilprin and *T. chipolana* Dall, before *T. Wilsoni* became entirely extinct. *T. chipolana*, which is found in the same bed (Alum Bluff, lower horizon) with the last specimens of *T. Wilsoni*, is distinguished from it by its shorter spire, more inflated whorls and singular long, cylindrical nucleus, recalling that of *Volutopupa*. Higher up in the Pliocene marls this form is succeeded by the large *T. regina* and *T. scolymoides*, whose somewhat degenerate recent descendants are the *T. ovoidea* and *T. scolymus* of the West Indies. *T. Wilsoni* is of moderate size, *T. polygonata* large, *T. chipolana* moderate, *T. scolymoides* larger than *T. scolymus*.

In the subgenus *Vasum* we begin with the *V. subcapitellum* Heilprin and the *V. engonatum* Dall of the Lower Miocene, both of which types persist, though modified, to the present time, while in the Pliocene the elegant *V. horridum* Heilprin made a brief sojourn and is not represented in any recent form.

Turbinella Wilsoni Conrad.

Turbinella sp. Lesueur, Walnut Hills Fossil Shells, pl. 3, fig. 14, 1829.

Turbinella Wilsoni Conrad, Journ. Acad. Nat. Sci. Phila. ii. vol. 1, p. 120, pl. 12, fig. 12, 1848 (Vicksburg).

Mazza Wilsoni Conrad, Cat. Eocene Foss. A. J. C. i. p. 23, 1865.

Vicksburg group, Upper Eocene, Vicksburg, Miss.; Lower Miocene at Alum Bluff (lower bed), West Florida; F. Burns.

The characteristics of this form are its somewhat flattened or subcylindrical last whorl, a constriction near the suture, which in the earlier whorls induces a presutural rounded band; a rather steep slope from the appressed suture to the obscurely nodulous shoulder; five or six rounded, distant, strong transverse ribs in front of the sutural band in the early whorls; a very acute, many-whorled, strongly sculptured upper spire, after the nucleus, with some seven ribbed whorls in an axial length of 20.0 mm., this cone having sometimes a base of 14.0 and a diameter in front of the nucleus of 1.3 mm.

A more thorough investigation of the Eocene and later Mesozoic strata will reveal the progenitors of this type of shell. I believe it most probable that they are an offshoot from the early *Volutidæ*, much like *Lapparia*, but more persistent. All the American species have normally three plaits, which on account of the great diameter of the pillar and the numerous whorls of the shell are very horizontal. Sometimes a short supernumerary plait is developed in front of the normally anterior plication, but this is an inconstant character.

It would not be surprising if the alleged *Turbinella scolymus* of the Santo Domingo Miocene, on more thorough inspection, should prove to be *T. Wilsoni* or an allied form, possibly the next species.

Turbinella polygonata Heilprin.

T. polygonata Heilprin, Trans. Wagner Inst. i. p. 108, pl. 15, fig. 43, 1887.

Miocene silex-beds of Ballast Pt., Tampa Bay; lower bed and upper bed at Alum Bluff on the Chattahoochee River, West Florida.

This species was described by Prof. Heilprin from a quite imperfect young specimen, but I refer it to fragments from Alum Bluff which exhibit a flat or even excavated space near the suture, bounded in front by a wavy keel set with flattened, triangular nodules. In the adult the body-whorl is smooth behind the canal, and the shell must reach a length of six or seven inches. The pillar is as solid as in *Vasum*, being nearly an inch in diameter in a moderate-sized specimen.

Turbinella chipolana n. s.

Plate 10, figure 7.

Near Chipola River, West Florida, one mile south of Bailey's Ferry, Calhoun Co., Florida; on Ten-Mile Creek, a mile west from the ferry; also at the corresponding horizon of the Lower Miocene (lower bed) at Alum Bluff.

This form would at first sight be taken for a variety of *T. Wilsoni* with a little shorter spire and more rounded whorls than that species, but a study of a good series shows the following distinctive characters :

The last whorl is rounded and not with flattened sides and the keel at the shoulder is obsolete; there is no presutural constriction or band; the whorls, except in the earliest on two, are not appressed, but distinct or even partially channelled; the space of 20.0 mm. from the base of the larval shell forward includes three and a half instead of seven whorls; instead of seven or more ribbed whorls there are but two or three; instead of uniform strong spiral threads as in *T. Wilsoni*, the spirals on the early whorls alternate coarse and fine; the whorls are gracefully rounded and not flattened; the diameter of the spire at the anterior end of the larval shell is 4.0 mm., instead of 1.3 mm.;

the spirals are finer and continue more distinctly over the whorls in the adult; the adult shell has six whorls beside the nucleus, *T. Wilsoni* has eleven or more in the same length.

T. chipolana varies, as all the species do to some extent, in its elongation and in the presence or absence of an umbilical chink; the aperture is more than half the length of the shell and has a prominent sinus behind; the apertural callus is prominent, the lip simple, the canal narrow and moderately differentiated. A rather short, thick specimen measures 120.0 x 55.0 mm., without the nucleus; a more elongated specimen 138.0 x 55.0 mm., the aperture being 85.0 mm. long. The nucleus is remarkable, consisting of more than four (none are complete) spirally striate, or smooth, regularly coiled whorls, probably preceded by a tip like that of *T. regina* (Pl. 10, fig. 7). The fourth of these whorls has exactly the same diameter as the first, so that the coil is nearly subcylindrical, having a length of 9 and a diameter of 3.5 mm. If to this we add the lost tip, we have a larval shell more elongated than that of *T. regina*, though the latter is by far the most slender shell.

Turbinella regina Heilprin.

Plate 3, figure 4.

T. regina Heilprin, *op. cit.* p. 74, pl. 3, fig. 5, 1887.

Caloosahatchie beds, on the Caloosahatchie River and Shell Creek in South Florida, in the Pliocene marls.

This fine and well-marked species has as many as eleven whorls after the nucleus, of which about five are transversely ribbed with five or six transverse ribs. The nucleus is peculiar, being composed of four whorls, of which the first is irregularly ovoid and more swollen than those which succeed it, being the primitive protoconch; the succeeding larval whorl, instead of being evenly rounded, as in the larva of *T. chipolana*, is constricted in front of the suture and has a peripheral keel, the next whorl or two are rounded and smooth until the normal shell-structure of the spire begins. The final whorl of the larva is of slightly less diameter than either of those which precede it. The specimen figured is 42.0 mm. long, but the adult attains ten times that length, with a maximum diameter of 105.0 mm.

Turbinella scolymoides n. s

Plate 3, figures 2, 5.

Pliocene of the Caloosahatchie beds.

Shell much resembling the recent *T. scolymus* L., especially when young, but having a more elongated and acute spire and canal, with two more whorls to the same diameter in the young shell; it is more globose, smooth and less ribbed on the body-whorl and with a proportionally shorter canal in the adult. Whorls ten or eleven without the nucleus, from which the protoconch has in all the specimens been lost during the life of the animal.

The larval shell without the protoconch appears to have had not to exceed one short whorl with incremental striæ, but it is, in the absence of a complete specimen, unsafe to form a conclusive opinion on this point. The minute sculpture of the young is exactly that of *T. scolymus*, but in the adult the fine sculpture and ribbing are obsolete and the body-whorl is inflated and nearly smooth. The pillar is straight, short, with a deep umbilical foramen, the whole shell is thin and light, considering its size. The suture is distinct and lies on a thin band of callus, in the last whorl, which extends a little behind the suture. The adult figured is 231 x 140 mm., but when perfect was about 260 mm. in length. The young tip figured has a length of 33.0 mm. The former was obtained by me from the Pliocene marl on the Caloosahatchie River, but specimens were subsequently collected on Shell Creek from the equivalent horizon by Mr. Willcox.

T. validus Sowerby has a channelled suture and small, rounded tubercles. It has not been figured, but would appear to be distinct. *Fasciolaria textilis* Guppy (Geol. Mag. 1874, pl. xvi. fig. 1) is a young *Turbinella* and may possibly prove, when adult specimens are found, to be identical with some of the species here discussed.

Subgenus **Vasum** (Bolten) Link.

By a *lapsus pennæ* the synonym, *Cynodonta* of Schumacher, was used by me in my Catalogue of the Marine Mollusks of the Southeastern Coast of the U. S., Bulletin of the U. S. Nat. Museum No. 37. The name *Vasum*, though without standing from Bolten's use of it, derived authenticity from its definition by Link, who preceded Schumacher by some years.

Vasum horridum Heilprin.

V. horridum Heilprin, *op. cit.* pp. 75, 132, pl. 4, figs. 6, 6 a; pl. 16 a, fig. 72, 1887.

Caloosahatchie beds, Pliocene marls of South Florida.

This magnificent species seems to be confined to these beds and to have given rise to no descendant in the recent fauna.

Vasum subcapitellum Heilprin.

Plate 4, figure 12.

V. subcapitellum Heilprin, *op. cit.* p. 109, pl. 15, fig. 44. Compare *Turbinellus ædificatus* Guppy, Journ. Geol. Soc. Lond., Nov. 1876, p. 523.

Miocene silex-beds of Ballast Point, Tampa Bay. Dall, Willcox, Burns and others.

I agree with Prof. Heilprin in regarding this species as specifically distinct from *V. capitellum* of the recent fauna, and also as being probably ancestrally related to it.

Vasum haitense Sowerby var. **engonatum** Dall.

Turbinellus haitensis Sowerby, Geol. Journ. VI. p. 50, 1850; Guppy, Quart. Journ. Geol. Soc., Nov., 1876, p. 523, pl. xxix. fig. 3.

? *Vasum tuberculatum* Gabb, Geol. Santo Domingo, p. 218, 1873.

Lower Miocene of Santo Domingo (?); Alum Bluff (lower bed), Chattahoochee River, West Florida; also the equivalent beds in the vicinity of Bailey's Ferry on the Chipola River; also the Miocene of White Beach, Little Sarasota Bay, South Florida.

This form is perhaps the ancestor of *V. cestus* Brod. and *V. muricatum* Born. *V. haitensis* Sowerby is closely related; it resembles *V. engonatum* in the flatness of the spire for the last three or four whorls, but was referred by Gabb to a variety of *muricatum*, which other details indicate not to be the case. *V. haitensis* has fewer spines and a more elevated and acute apex than the form now under consideration.

V. engonatum differs from *V. muricatum* when adult in having the suture appressed closely to the angle of the preceding whorl; in its less prominent apex; in its finer and much more numerous spirals; in its larger, more prominent and conical spines, which are less by one or two in number, on the angle of the last whorl; in its single series of very large and conical spines anteriorly (*cestus*, *muricatum*, and *haitense* have two or even three series); in its more prominent siphonal fasciole enclosing a larger umbilical depression; and in its broader pillar and more triangular form. In *V. cestus* the spines are blunter and the spirals still coarser than in *V. muricatum*. Alt. of shell 96.0; diameter about 94.0; alt. of aperture 80.0 mm. There are three or four plaits on the pillar, the posterior plait much larger than the others.

V. tuberculatum Gabb is a remarkable form, with few enormous spines, bearing much such a relation to *haitense* as *haitense* does to the present variety. Without a connecting series I should hesitate to consolidate them, as Guppy has done.

FAMILY FASCIOLARIIDÆ.

SUBFAMILY FASCIOLARIINÆ.

There is no doubt that in the beginning of the Tertiary this family was not developed sufficiently to be separated from the *Volutidæ*, the connecting links which then existed rendering it impracticable to draw family distinctions between the then nascent groups. But with the increase in development and the extinction of the connecting forms, in the recent fauna the family rank may be admitted.

We should not lose sight of the genetic connections in realizing the differentiation.

Genus **LIOCHLAMYS** Dall.

Liochlamys Dall, Rep. Blake Gastr., pp. 15, 173, 1889.

Mazzalina sp. Heilprin, *op. cit.* p. 76, 1887.

Shell resembling a short, globose *Fasciolaria* with three plaits on the pillar, which sometimes terminate in faint divarications or obscure pustulations; the surface of the whole shell covered with a polished coat of enamel, obscuring the sutures, as in *Dipsaccus* or *Cypræa*.

Liochlamys bulbosa Heilprin.

Plate 7, figure 10 b.

Mazzalina bulbosa Heilprin, Trans. Wagner Inst. I. p. 76, pl. ii. fig. 7, 1887.

Liochlamys bulbosa Dall, Rep. Blake Gastr., pp. 15, 173, 1889.

Caloosahatchie beds, not common.

In the original specimen of this elegant shell the enamel on the body was more or less decorticated and the usual spiral sculpture of the canal and body, running into the aperture, presented somewhat the aspect of *Mazzalina* or *Lagena*. This misled Prof. Heilprin in referring the shell to its generic place. An examination of Conrad's type-specimen of *Mazzalina* convinces me that it is entirely distinct from this shell, though its relations would be with *Fasciolaria* and its allies. The present species is distinctly a *Fasciolaria*, with an envelope of enamel which must have been applied by an extension of the mantle not known in *Fasciolaria* proper. The plaits are normally three, but very old specimens show some obscure bifurcations of the callus near their terminations. There are no plaits on the upper part of the pillar or on the body; the pillar is deeply arcuate and the canal extremely short, while the doubly arcuate outer lip is thin and sharp and the throat profusely and finely lirate. The fossils show no traces of any color-pattern. The sutures and nucleus are hidden under the profuse and brilliant enamel.

Genus **FASCIOLARIA** Lamarck.

Fasciolaria tulipa Linné.

Plate 7, figure 11.

Murex tulipa Linné, S. N., p. 1223, 1768.

Fasciolaria tulipa Lam., Prodrome Nouv. Class., p. 73, 1799.

Caloosahatchie beds, rare. Post-Pliocene of the Carolina coast. Recent on the coast of the United States from North Carolina to Florida and southward to Venezuela and St. Thomas.

This species is distinguished from *F. distans* by its color-pattern; its spiral sculpture, especially several grooves which slightly appress the whorl in front of the suture; by the absence of any internal ridge on the body in front of the suture; the ornamentation of its ovicapsules, and its normally larger size and lighter construction when adult.

A specimen exactly agreeing with the recent form, with the whole surface grooved spirally, was obtained from the marls.

Mr. W. M. Gabb (Journ. Acad. Nat. Sci., 2d series, viii. p. 354, 1874) took the hasty and inaccurate view that *F. tulipa*, *F. distans* and the fossil *F. semistriata* and *F. rhomboidea* Rogers were one and the same species. *F. semistriata*

Sowerby, collected by Heniker from the Miocene beds of Santo Domingo, has not been well figured. The description reads like that of *F. tulipa* var. *obsoleta*, a nearly smooth, recent form from St. Thomas. In Guppy's figure (Quart. Journ. Geol. Soc. xxii. pl. xvi. fig. 12, 1866) the specimen is evidently immature and very ventricose in its last whorl. In the absence of specimens or good figures, I do not dare to unite them. It is very probable, however, that this form is nearly related to *F. tulipa*. In that case the line of ascent would be carried to the Miocene. The divergency between *F. tulipa* and the type now represented by *F. distans* is at least as old as this, since we find both types characteristically developed in the southern Pliocene of the United States.

The specimens in the Philadelphia collection identified by Gabb with *F. semistriata* agree fairly well with this figure, and I am disposed to regard the species as distinct.

Fasciolaria distans Lamarck.

Plate 7, figure 10.

Fasciolaria distans Lam., An. Sans Vert. vii. p. 119, 1822. Tuomey & Holmes, Post-Pleioc. Foss. S. C., p. 151, pl. xxx. fig. 7, 1856. Holmes, Post-Pleioc. Foss. S. C., p. 63, pl. x. fig. 5, 1860.

Fasciolaria tulipa Gabb, Tryon *et al.* not of Lamarck.

Pliocene of South Carolina (?). Post-Pliocene of S. Carolina and Florida. Recent on the coast of the United States from North Carolina to Florida and Texas.

Fasciolaria (**distans** subsp. ?) **rhomboidea** Rogers.

Fasciolaria rhomboidea Rogers, Trans. Am. Phil. Soc., new ser., vi. p. 376, pl. xxx. fig. 3, 1839. Conrad, Proc. Acad. Nat. Sci. Phila. xiv. p. 561, 1863.

Fasciolaria distans Emmons, Geol. N. C., p. 252, fig. 113, 1858, *ex parte*. Tuomey & Holmes, Pleioc. Foss. S. Car., p. 151, pl. xxx. fig. 8, 1856.

Miocene of Virginia (Rogers), Western Florida at Alum Bluff (upper bed, Burns), and of North Carolina, Dauphin County, Haldeman and Emmons. Pliocene (?) of South Carolina, Tuomey & Holmes.

This form differs from the recent *distans* in its more acute and longer spire, smaller body-whorl, shorter and wider canal, and in having the first three or four whorls spirally sulcate and without transverse sculpture. As far as one can judge from the traces of coloration, it resembled the recent form at least in having the few dark spiral lines.

Fasciolaria (**distans** subsp.?) **apicina** Dall.

Plate 7, figure 11 b.

Pliocene of Florida in the Caloosahatchie beds.

This form differs from the recent *distans* in being more slender, with the whorls less rounded, the suture somewhat appressed and less distinct, and especially in the sculpture of its first three or four whorls.

In *F. distans* (recent) the nucleus is smaller than the first whorl, smooth, subglobular, and is followed by a nearly smooth half whorl; then the succeeding coils to the number of two are faintly spirally sulcate, with two or three channels behind the periphery and ten or fifteen in front of it. The shell soon becomes perfectly smooth and remains so, except on the canal. It is colored with a peculiar flammulated or transversely nebulous pattern of livid olive which fades to brown on a creamy white ground. The nuclear whorls are uniformly brownish at first, but in adults have usually become paler than the rest of the shell by fading.

In *F. apicina* the nucleus is swollen and often larger than the first succeeding whorl. The latter is sculptured with numerous equal, distinct, transverse ribs extending across the whorl and without spiral sculpture. The spirals appear suddenly in the shape of about five strong, flattish, elevated bands, of which the two anterior are shorter than the rest. The transverse ribs become more distant and are visible only as the spirals rise and become swollen in passing over them. There are about ten to the whorl of these waves or riblets; they are strong at the periphery, but do not reach the sutures. The fossils preserve their color well in many specimens and show the nucleus pale or white, the spirals remain pale in front of the suture and where they are swollen on the crests of the waves; between the waves and in front of the periphery the color is dark reddish brown, so that the nodules stand out prominently by contrast. After the third or fourth whorl this sculpture fades away and the color seems to have been nearly uniform dark reddish brown, with a tendency to a white band or bands in front of the suture. No transverse flammulations appear anywhere. The surface is smooth and there is an internal presutural elevated rib as in *F. distans*. In the type and all the varieties there are from five to eight spiral narrow dark lines on the body-whorl. These spirals are harder than the rest of the shell and in decorticated specimens of the fossils often appear as slightly elevated lines.

Fasciolaria (distans var. ?) **monocingulata** Dall.

Caloosahatchie beds.

This variety may be the result of parasitism or disease, but, however produced, the differences are too marked to leave unnoticed. The fossils resemble the recent *F. distans*, but have a deeply impressed line in front of the suture and usually on the last two whorls another behind the suture, but less strong. These make the suture much more prominent than in the recent shell and its margin is usually somewhat crenulated. It is possible that this may be due to some annelid building its tube along the suture and so producing an abnormal growth, as is sometimes seen in recent shells; but some young specimens show the gradual progress of this margination from the very apex, which would hardly agree with the above suggestion.

The dimensions of specimens of the same length are as follows:

	Total length.	Spire.	Width.
F. distans	101.0	40.0	47.0 mm.
F. rhomboidea	102.0	50.0	46.0 mm.
F. apicina	101.5	40.0	41.0 mm.
F. monocingulata	88.0	33 0	42.0 mm.

The *F. rhomboidea* is undoubtedly the progenitor of the race, including probably *F. tulipa*, as well as *F. distans* of the recent fauna. In the Pliocene we have *F. tulipa*, *F. apicina*, *F. monocingulata* and possibly *F. distans*, though I have seen no unmistakable *distans* of earlier than Post-Pliocene age, and Tuomey and Holmes's figure 7 is not absolutely decisive. Besides this, I have no doubt that the fossils supposed to be Pliocene by Tuomey and Holmes were mixed with specimens really of Miocene age, but supposed to belong to the same horizon as the others; as in the case of *Ecphora quadricostata*. The unconsolidated state of the later Tertiary beds of South Carolina makes it easy to fall into such an error. From the above confusion Conrad was led to an error of greater magnitude in the other direction, by which he referred the whole of the Carolinian Pliocene to the Miocene age.

Fasciolaria Sparrowi Emmons.

F. Sparrowi Emmons, Geol. Rep. N. Car., p. 253, fig. 115, 1858.

Miocene marl of Bladen Co., North Carolina (Emmons); Lower Miocene of Western Florida one mile west of the Chipola River, Calhoun Co. (Burns); and of White Beach, Little Sarasota Bay, Southwest Florida (Dall).

The Floridian specimens are fragments, but identified with confidence; though similar in a general way, this form seems sufficiently distinct from the next species, which probably was its descendant.

Fasciolaria scalarina Heilprin.

F. scalarina Hp., *op. cit.* p. 69, pl. 1, fig. 2, 1887.

Caloosahatchie beds on the Caloosahatchie River and Shell Creek.

This splendid species seems to have no recent representative. It appears to be sufficiently distinct from *F. Sparrowi* for the reasons given by Prof. Heilprin.

Fasciolaria gigantea Kiener.

F. gigantea Kiener, Icon. Coq. Viv., p. 5, pl. 10, 11; Heilprin, *op. cit.* p. 70.

Caloosahatchie beds on the Caloosahatchie River, Shell Creek and Alligator Creek, Florida, not rare; Pliocene of South Carolina; Post-Pliocene, and recent on the whole coast of the United States south of Hatteras.

The Pliocene form does not appear to differ from the recent shell and passes through a similar series of nodulations and other variations in ornamentation. The nucleus is almost identical with that of *F. scalarina*.

"**Fasciolaria**" **Woodii** Gabb.

F. Woodii Gabb, Journ. Acad. Nat. Sci. Phila. iv., 2d series, p. 375, pl. 67, fig. 7, 1860.
Fasciolina Woodii Conrad, Am. Journ. Conch. iii. p. 186, 1867.
Cuma tectum Gabb and Guppy, not Wood or Kiener.

Miocene of Santo Domingo and of New Jersey (Shiloh).

In examining Gabb's types I found that his *Fasciolaria Woodii* is an unquestionable *Cuma*, and identical with the species from Santo Domingo which he afterwards erroneously referred to the entirely distinct *C. tectum* Wood, a West American recent species.

Subgenus **Mazzalina** Conrad.

Mazzalina Conrad, Journ. Acad. Nat. Sci. ii., vol. iv. p. 295. Type *M. pyrula* Conrad.

The type and hitherto unique species and specimen upon which Mr. Conrad has founded this subgenus is, as Mr. Tryon remarks, very like *Lagena*, but I regard it as distinct. It seems to me that *Mazzalina* is a *Fasciolaria* of short, stout form with supplementary, *Latirus*-like plaits imposed on its columella, while *Lagena* (Schumacher, Tryon, typified by *L. smaragdula* L.) is a smooth, bucciniform *Leucozonia*.

The species which Prof. Heilprin referred to *Mazzalina* differs by the absence of the supernumerary plaits and by the superficial coat of enamel by which the whole shell is covered. I have already separated it under the name of *Liochlamys*. To make amends I have now two forms to be added to the true *Mazzalina*, which will make three species in the American Miocene.

Mazzalina Oweni Dall.

Fusus sp. Owen, Second Geol. Rep. Arkansas, p. 35, plate ix. fig. 1, 1860.

White Bluff, Jefferson Co., Arkansas, Middle Eocene.

Owen's types were deposited in the National Museum, and are before me as I write. The specimens, except when fully adult, show the plaits on the pillar only to an oblique view, so they do not appear on that figure. When young the species has three plaits on the pillar like *Fasciolaria*. At the first resting-stage, however, more are added, and thereafter are continuous, increasing to eight or nine in the fully mature shell; the surface is much like that of Conrad's type-species, but the shell is smaller and more slender; the young have the suture crenulated minutely by its being laid on a peripheral crenulated keel of the first two or three whorls; this keel becomes faint and smooth on the later whorls, obscurely indicating a shoulder to the whorls, which number in all about seven, with the outer lip internally callous and lirate. The nucleus is small and fusoid; the canal spirally striate externally. The adult measures 34 x 19 mm.; Owen's figure is somewhat too slender. It is doubtless the species referred to on page 35 as *Fusus Fittoni* (Lea), to which it bears a considerable but wholly superficial resemblance. Most of the specimens are obscurely constricted between the suture and the shoulder, which is not well shown by Owen's figure. The species has since been collected by the State Geological Survey under Dr. John C. Branner at the same locality and is accompanied by a species of *Macron* of rather similar external form. *Lagena rhomboidea* Gabb (Geol. St. Dom., p. 218, 1873) is, from the types, a young *Mazzalina* much resembling *M. Oweni*, but more slender and with a proportionally longer canal.

Mazzalina costata n. s.

Compare Tryon, Struct and Syst. Conch. II. pl. 48, fig. 100.

As Conrad's type-specimen of *M. pyrula* has so far remained unique, its limits of variation are uncertain, but in the Miocene of the Chipola River near Bailey's Ferry, West Florida, and in that of White Beach, Little Sarasota Bay, South Florida, is a species which differs from it in the following particulars:

It is wholly covered with not very prominent, coarse spirals crossed by distinct incremental lines instead of being smooth behind the canal. It has eight or nine wide, rounded, prominent costæ, which begin in front of the shoulder and extend forward to the suture, which is undulated by them. It has three strong, continuous plaits on the pillar, the anterior of which is undulated instead of simple on its edge, and two or three supplementary, fainter ridges appear behind the others at maturity. The adult shell has six or seven whorls and the canal is narrower and proportionately a little longer than in *M. pyrula*. The young are more slender than *M. pyrula*, but the adult is quite globose, and the costæ are obsolete on the last whorl. The adult measures about 48 x 30 mm.

My specimens of this form are too fragmentary and imperfect to be suitable for figuring, but they appear to me to be quite distinct from the Eocene species.

Genus **LATIRUS** Montfort.

Latirus floridanus Heilprin.

Plate 8, figure 2.

Latirus floridanus Heilprin, *op. cit.* p. 108, pl. 15, fig. 42, 1887.

Miocene silex-beds of Ballast Point. Also in the uppermost Eocene beds (nummulitic) near Martin's Station, east from Tampa.

This species reaches a length of 55 and a maximum diameter of 23 mm. The aperture, including the canal, reaches a length of 32.5 mm. The whorl slopes up obliquely to and is appressed at the suture; the spirals are close-set and alternate in size, only one fine one between two coarse ones; there are nine ribs or costæ on the last whorl. There are two obscure plaits on the pillar, not visible from in front and rather weak; they are close to the anterior edge of the pillar. In fully adult specimens three or four not prominent, somewhat irregular liræ appear on the pillar. The figure, which was taken from a somewhat immature specimen, does not show these, but they are arranged much as in figure 7 on the same plate. The intercalary fine lines were also very faint on this specimen and the draughtsman has not brought them out. One fine thread should appear between each pair on the figure, though these are so fine that in a drawing of the kind used here they would hardly be perceptible.

Latirus (**floridanus** var. ?) **multilineatus** Dall.

Ballast Point silex-beds.

This form differs from the type in being larger and stouter, in having ten or eleven costæ on the last whorl, and in having two or three very fine spirals between every two coarse ones on the last whorl. The apex is shorter and very acute. Lon. 57.0; lat. 27.0 mm. It has eight whorls like the type, and in other respects resembles it.

Latirus rugatus n. s.

Plate 8, figures 6, 7.

Ballast Point silex-beds, Dall & Burns.

Shell with eight whorls and generally resembling *L. floridanus*, except in the following particulars: It is considerably smaller, with the same number of whorls; the whorls are more inflated and rounded instead of sloped to the suture behind them; on the early whorls (except the nucleus, which is smooth) a prominent spiral marginates the suture; the costæ are more prominent and extend farther either way from the periphery; the lines of growth are more prominent; the primary spirals are stronger and more distant, at the beginning of the last whorl there are six in *L. rugatus*, as against twelve in *L. floridanus;* the canal is more recurved and more constricted at its junction with the aperture; the liræ are stronger, and that at the posterior commissure on the body is much stronger than in *L. floridanus*. Lon. 37.0; max. diam. 18.0; lon. of aperture 20.0 mm.

This is probably the form referred to by Heilprin as a variety or possibly distinct species from *L. floridanus* (*op. cit.* p. 106). It is extremely closely related to a West Indian form usually referred to *L. brevicaudatus*.

Latirus callimorphus n. s.

Plate 8, figure 1.

Ballast Point silex-beds, rare.

Shell thin, stout, with seven whorls; sculptured with ten transverse costæ or short riblets confined to the periphery, and close-set, prominent incremental lines; spirals close-set, alternate, of three sizes; the primaries and secondaries on the last whorl not very different in size, but simple, the tertiaries very fine and reticulated by the lines of growth; the tertiaries hardly visible on the upper whorls; suture appressed, the whorl flattened and sloping in front of it; pillar with two or three obscure plaits hidden within the aperture; there is no ridge on the body at the commissure; canal short, wide, recurved. Max. diam. 20.0; lon. 41.5; lon. of the aperture, including the canal, 23.0 mm.

A single specimen of this interesting species was collected by the writer. It is of the same type as the preceding forms, from which it is at once distinguishable by its relatively shorter and wider canal and finer sculpture and generally stouter form. In a perfectly adult specimen there may be liræ on the body and within the inner lip as in the other species.

Latirus tessellatus n. s.

Plate 10, figure 8 a.

Shell elongated, slender, with the spire longer than the aperture; apex acute; early whorls worn, but evidently sculptured much like the rest; spiral sculpture of, on the last whorl, between the suture and the shoulder four or five low, flattened bands, separated by wider interspaces; at the shoulder and in front of it to the end of the canal, fifteen more elevated primary, distant threads; the flattish interspaces are divided by two or three rather weak grooves into two or more bands, which, by regularly spaced impressed transverse lines, are cut more or less distinctly into little squares; the transverse lines do not cut the primary threads, but appear between them, the tessellation being most distinct at and partly in front of the periphery; transverse sculpture, beside the impressed lines and those due to growth, consisting of nine rounded, rather stout ribs beginning near the shoulder and extending over the whorl, with about equal interspaces; suture appressed, distinct, made flexuous by passing over the ribs; whorl somewhat constricted in front of the suture; aperture elongate; outer lip crenulated by the sculpture, internally lirate, the liræ falling short of the margin, inner lip callous, with two or three faint ridges near the edge of the canal; canal narrow; pillar nearly straight. Lon. of shell 37.5; of aperture 17.0; max. diam. of shell 12.7 mm.

A single specimen of this interesting species, with the upper whorls somewhat worn, was collected from the Caloosahatchie marls.

Latirus hypsipettus n. s.

Plate 10, fig. 5.

Shell elevated, slender, acute, nine-whorled, with strong sculpture and a very short canal; nucleus smooth, subglobose, of a whorl and a half; subsequent whorls with spiral sculpture of (on the last whorl about nine) strong, distant threads, with much wider, rather smooth interspaces; of these threads three appear on the upper whorls, the posterior thread somewhat the most prominent; between the latter and the suture behind it the whorl is appressed toward the suture and shows a few much finer spirals, but these are absent between the primaries; transverse sculpture of rather marked lines of growth, rarely raised and imbricated near the suture, and (on the last whorl seven) stout, rounded ribs, obsolete near the suture and on the canal; base of the whorl constricted; canal short, deep, nearly straight, with a strong fasciole; outer lip simple, internally lirate?, inner lip callous, with one or two plaits anteriorly. Lon. of shell 25.0; of aperture 10.8; max. diam. of shell 10.3 mm.

A single nearly adult and several young specimens were found in the Caloosahatchie marls.

This species is distinguishable from the preceding by its shorter canal, stronger sculpture, absence of tessellated sculpture between the spirals and of the presutural constriction. It does not seem closely related to any known recent species of the local fanna.

Genus **FULGUR** Montfort.

>*Fulgur* Montfort, Conchyl. ii. p. 503, 1810. Type *F. carica* var. *eliceans* Montfort.

Busycon Bolten, Mus. Bolt., p. 149, 1798. No diagnosis, type or figure.

>*Sycopsis* Conrad, Am. Journ. Conch. iii. p. 184, 1867.

>*Sycotypus* (Browne) Gill, Am. Journ. Conch. iii. p. 147, 1847. Not of Gray.

This group of forms, which I here write under the earliest properly defined name, took its rise in the Eocene formation. Its precursors may be noted in such forms as *Levifusus Blakei* and *trabeatus* Conrad, *Bulbifusus inornatus* Conrad (*Fusus Fittonii* Lea), "*Fulgur*" *triserialis* Whitfield, from the Claibornian, and the Miocene *Pyrula* (*Lyrosoma*) *sulcosa* Conrad. To trace the gradual steps by which from small, bulbous, mostly rather thin shells of this family the enormous and ponderous forms of the Miocene and subsequent faunas have been derived would be a fascinating task, but for which space and time at present afford no opportunity. It will be sufficiently obvious, to any one who will carefully study a full series of these forms, that their essential shell-features at least had been already assumed at the epoch of the deposition of the Claiborne sands.

The noun *Fulgur* is neuter. I find great discrepancies in the manner in which authors have treated the specific names at various times, but the proper ending (in *um*) seems to be that which has been least frequently employed. Considering the small number of recent species, there does not seem to be any real necessity for maintaining two sections in the genus, which did not exist before the Miocene period, though if the recent species were numerous the sections might be convenient.

I have found it necessary to considerably reduce the number of nominal species, and to add to the list two hitherto unrecognized but very distinct forms.

Fulgur spiniger Conrad.

Fusus spiniger Conrad, Journ. Acad. Nat. Sci. Phila. i. 2d ser. p. 117, pl. xi. fig. 32, 1848.

Fulgur spiniger Conrad, *op. cit.* p. 207, 1849. Gill, Am. Journ. Conch. iii. p. 147, 1867; Heilprin, Trans. Wagner Inst. i. p. 108.

Busycon spiniger Conrad, Am. Journ. Conch. iii. p. 184, 1867.

Fulgur nodulatum Conrad, Journ. Acad. Nat. Sci. Phila. i. 2d ser. p. 207, 1849; ii. p. 41, pl. i. figs. 6, 7; Proc. Acad. Nat. Sci. Phila. vi. p. 317, 1854.

Busycon dumosum Conrad, Am. Journ. Conch. iii. p. 266, pl. 19, fig. 3, 1867.
Fulgur nodulatus Gill, Am. Journ. Conch. iii. p. 147, 1867.
Busycon (*Sycopsis*) *nodulatum* Conrad, Am. Journ. Conch. iii. p. 184.
Busycon striatum Conrad, Am. Journ. Conch. ii. p. 69, pl. 3, fig. 8, 1866 (young).

It was very natural that Conrad should have described as distinct species and even placed in two distinct subgenera extreme forms of this protean species. Both in the Upper Eocene (Vicksburg) and the Lower Miocene (Chipola River, near Bailey's Ferry and Alum Bluff, Chattahoochee River, as well as the Tampa silex-beds) it riots in variation so luxuriant that one would have good reason for naming half a dozen species, were these forms not absolutely connected by the most trifling individual gradations. The spire may be scalar or have the suture wound accurately on the keel. The keel may be simple, tuberculous, or represented by a series of unconnected spines. The external spirals may be numerous and fine, few and coarse, or, on the periphery, obsolete; the space between the suture and the shoulder may be sloping, flat, or excavated. The principal types are as follows:

F. spiniger var. *nodulatum* (Conr.). Spire low, whorls keeled, suture wound on or near the keel; shoulder flat, sloping; keel more or less nodulous, sometimes subspinous; striation fine, often obsolete on the periphery; pillar with one groove; throat lirate; body with an internal ridge near the suture in adults. Lower Miocene near the Chipola River, W. Florida. In examining the types of this species in the Museum of the Academy of Natural Sciences in Philadelphia, I found that on the same tablet with the genuine *F. nodulatum* is included one specimen of young *F. coronatum*.

F. spiniger var. *spiniger* (Conr.). Spire more elevated, subcarinate; shoulder excavated, appressed at or near the keel; keel at first obscure, with many pointed nodules, later with only isolated spinous nodules.

Upper Eocene at Vicksburg, Miss. Lower Miocene near the Chipola River, West Florida.

This form has the spirals as strong as or stronger than var. *nodulatum* where present, but the periphery is often bare of spirals altogether, and there is frequently a narrow, smooth band in front of the suture, occasionally a little excavated, which is the herald of the sutural channel in subsequent forms. As the var. *spiniger* increases in size the spines become more imbricate or like those of *F. perversum*, with the anterior slope much the shorter. In small and average specimens the two slopes are nearly alike measured in the direction of the whorl, or spirally. Large ones measure 80 mm. long.

F. spiniger var. *Burnsii* Dall. Spire moderate; keel often nodulous or even faintly undulate, instead of spiny; shoulder flattish, with a thick band or swollen cord at the suture, which is deep, though not quite channelled; spiral sculpture sparse, but very coarse; periphery smooth; internal liræ prominent and continuous, rather sparse; infra-sutural callus strong and sharp. Max. lon. observed, about 65 mm. The spire varies from depressed to slightly scalar. When spiny this variety has numerous (13–15) small spines on the last whorl, instead of few (10–13) large ones, as in var. *spiniger*.

Lower Miocene at Alum Bluff (lower bed) and the vicinity of Bailey's Ferry, Chipola River, W. Florida.

This variety is named in honor of Mr. Frank Burns, of the U. S. Geol. Survey, to whose energy and faithfulness in collecting our paleontologists are greatly indebted.

F. spiniger var. *tampaensis* Dall. Shell resembling the last, but with the spire more scalar, the top of the whorls more horizontal; the edge in front of the suture not thickened or pressed up on the preceding whorl, but with a narrow, smooth space between the suture and the first spiral in front of it; while in the varieties previously described the spirals are equal, or subequal, and absent on the periphery, in this they alternate coarser and finer, uniformly over the shell; the lines of growth, too, are more prominent and give the sculpture a sharp appearance.

This is the commoner form in the Tampa silex-beds, and probably that referred by Heilprin (*op. cit.* p. 108) to *spiniger* with doubt, from an imperfect specimen. It is generally about 45 mm. long, but fragments indicate that it reached a length of three or four inches, preserving the characters above mentioned. It has been collected by Mr. Willcox, the writer, Messrs. Shepard, Burns and others. The internal liræ are sharp and persistent.

F. spiniger var. *perizonatum* Dall. Shell resembling the last, but with a prominent thread in front of the sutural smooth band, which may be more or less excavated, forming a shallow or sometimes a very marked canaliculation; the internal liræ are strong; the keel may be tuberculate or spinose, the spire more or less scalar.

Rare in the silex-beds at Ballast Point. This is the form mentioned by Heilprin (*l. c.*) as *Fulgur coronatum*, to which the upper part of the whorl bears a certain resemblance; but that species is quite distinct. I have not in a large series been able to find any internal liræ in *F. coronatum*, though they may appear in very aged specimens. It is also a much larger species, with a smoother surface, than the Floridian shell.

The present form shows such gradations in the few specimens examined that it is evident that the canaliculation of the whorls at the time these animals lived was a character so little fixed that it was not even of specific, to say nothing of subgeneric, value, as it has been reckoned to be in the species making up the recent fauna.

Fulgur scalarispira Conrad.

F. scalarispira Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 584.

Miocene marls at Shiloh, Cumberland Co., Southern New Jersey; also in the upper bed of the Miocene at Alum Bluff, Chattahoochee River, W. Florida.

A single imperfect specimen was found at Alum Bluff, but the species could not be mistaken. This species has a deep chink in the suture, not wide enough to be called a channel, and varies remarkably in the elevation of the spire, which is more accurately scalar when the spire is depressed; more oblique, with the shoulder somewhat excavated and appressed, when the spire is elevated. This species also illustrates the want of equilibrium so clearly shown by the variations of *F. nodulatum.*

Fulgur pyrum Dillwyn.

Bulla pyrum Dillwyn, Des. Cat. Rec. Sh. i. p. 485, 1817.
Pyrula spirata Lamarck, An. s. Vert. vii. p. 142, 1822.
Fulgur pyruloides Say, Journ. Acad. Nat. Sci. Phila. ii. p. 237.
Busycon plagosum Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 583.
Busycon elegans Conrad, *loc. cit.* p. 583, 1862.
Sycotypus pyriformis Conr., Am. Journ. Conch. iii. p. 265, pl. 20, fig. 1, 1867.
Fulgur pyriformis Heilprin, Trans. Wagner Inst. i. p. 74.

Upper Miocene to recent fauna.

Fulgur pyrum var. **incile** Conrad.

Fulgur incile Conrad, Am. Journ. Sci. xxiii. p. 333, 1833.
Busycon Conradii Tuomey & Holmes, Pleioc. Foss. S. C., p. 147, pl. 29, fig. 4, 1856.
Sycotypus incilis Gill, Am. Journ. Conch. iii. p. 149, 1867.
Busycon alveatum Conrad, Proc. Acad. Nat. Sci. 1862, p. 583, Am. Journ. Conch. ii. p. 68, pl. 3, fig. 7, 1866.
Sycotypus alveatus Gill, Am. Journ. Conch. iii. p. 149, 1867.
Busycon canaliculatum Tuomey & Holmes, *op. cit.* pl. 29, fig. 2, p. 146, *ex parte* (not of Lamarck), 1856.
Busycon canaliferum Conrad, Proc. Acad. Nat. Sci. 1862, p. 260.
Busycon carolinense Conrad, *op. cit.* p. 584 ; not p. 560.
Sycotypus canaliferus Gill, *op. cit.* p. 149, 1867.

Miocene of Maryland, Virginia, N. and S. Carolina, Florida.

Fulgur pyrum var. **excavatum** Conrad.

Fulgur excavatus Conrad, Am. Journ. Sci. 2, xxxix. p. 387, 1840.
Busycon excavatus Conr., Foss. Tert. Form. U. S., p. 82, pl. 45, fig. 12, 1845 ; Proc. Acad. Nat. Sci. Phil. vii. p. 30, 1854.
Cassidulus carolinensis Tuomey & Holmes, Pleioc. Foss. S. C., p. 147, pl. 30, fig. 1, 1856.
Busycon excavatum Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 560.
Busycon carolinense Conrad, *op. cit.* p. 560 (not p. 584), 1862.
Sycotypus excavatus Gill, Am. Journ. Conch. iii. p. 150, 1867. Conrad, *ibid.* p. 267, pl. 23, fig. 6.
? *Sycotypus elongatus* Gill, *loc. cit.* p. 150, fig., 1867.

Miocene of Maryland, Virginia, North Carolina, and Pliocene of Florida and South Carolina.

Fulgur pyrum var. æpynotum Dall.

Miocene of Alum Bluff, upper bed, Chattahoochee River, West Florida.

This remarkable form appears of large size and strong development (95 x 150 mm.) in the Lower Miocene, where the typical variety (*incile*) has round and swollen whorls, contracted base and deep, wide sutural channel. It is covered with fine sharp spirals; the shoulder is only emphasized in the young, when it is tuberculous. In the adult it is rounded off in the last whorl. A variety has a narrow sutural canal and wide, carinate shoulder, with low tubercles on the keel. It is *canaliferum* of Conrad and may be regarded as the offshoot from which proceeded the living *canaliculatum*. Another variety, *æpynotum;* which I suspect was confined to the young shells, which, probably, if they attained full size, gradually lost their distinctive features on the later whorls; has a medium sutural canal, an excavated, keeled shoulder, undulate or subtuberculate and very coarse, broad spirals with wider interspaces. The largest specimen I have seen is 30 x 50 mm. With these are intermediate specimens leading directly to the *excavatum* form, though I have not yet seen any genuine typical *excavatum* from the Miocene of Florida, though it appears in South Carolina and northward. As time went on the *excavatum*, variable at its best, on the whole changed in two respects: the whorl became rounder and the channel at the suture less deep and wide. The height of the spire and the coarseness of the spiral sculpture are always variable in these fossils, hence I feel obliged to refer Gill's *elongatum* to these species, though the unique type seems to have been mislaid, and I can only judge from the figure and description, which lend themselves to this view.

F. excavatum was, on the whole, larger than the specimens of the recent *pyrum* which I have seen, and this is also true of the Pliocene form from the Caloosahatchie and Shell Creek, and the Myakka River Post-Pliocene specimens collected by Mr. Willcox. The Pliocene form is nearer the recent form than typical *excavatum* is, the Post-Pliocene still nearer, or practically identical with the living shells. All through the series the height of the spire, the angularity of the shoulder and the coarseness of the striation (especially in the very young) are variable factors. The recent shells are more uniform in their spiral sculpture than any of their fossil progenitors, but they differ similarly in the height of the spire and the excavation of the sutural canal. I feel that it is impossible to frame a specific diagnosis that shall accurately describe the fluctuations of the four forms I have treated as varieties and at the same time discriminate them. For this reason I have not regarded them as entitled to specific rank. Beside those I have mentioned, there is a curious variety in the Post-Pliocene which has the shell very pyriform, almost smooth, with no keel on the shoulder and with a very narrow sutural channel. It connects with the others by degrees.

Beside the species above limited, I know of but two valid species of the *Sycotypus* section of the genus. These are *F. coronatum* Conrad and its variety *rugosum* (Conrad) and the recent *F. canaliculatum* Linné. The former is Miocene, from the Carolinas northward, the latter is found in the same area of the Pliocene and Post-Pliocene, and may extend farther south, but I have not seen it from the Pliocene of Florida.

Fulgur (**pyrum** var. ?) **planulatum** n. s.

Shell Creek, Willcox, Caloosahatchie marls, Dall.

Shell small, six-whorled, with a small, smooth nucleus of one and a half whorls; the very small whorls immediately following the nucleus are spirally striate, with a flattish, relatively broad, minutely undulate or granular keel at the shoulder, behind which the whorl is flattish or slightly excavated, with a narrow and very feeble channel at the suture; beyond this the tubercles, keel and channel become obsolete, the shoulder subangular or almost rounded, the posterior surface of the whorls flat and smooth, and in front of the suture, which is wound on the exact periphery, there is only the faintest possible depression or rather downward slope to the preceding whorl; except for a few sparse, obsolete spiral lines, the periphery is smooth; the somewhat constricted base of the whorl is spirally threaded, with a tendency to alternation in strength; canal long, moderately slender; outer lip meeting the periphery nearly at right angles, simple, sharp-edged, nearly straight; body with little callus, pillar callous at the edge, sharply grooved; throat not lirate inside. Lon. 54, lat. 31 mm.

This shell is exactly intermediate between the channelled and the unchannelled Fulgurs. If a specimen of *pyrum* with a scalar spire were to have the top of the whorls levelled off, the periphery become smooth and lose the liræ of the outer lip, it would be something like this shell. One was found at Shell Creek by Mr. Willcox and one on the Caloosahatchie by the writer. It does not seem possible that *pyrum* could vary to this extent, yet there is nothing else to compare it to, and the paucity of material makes me hesitate to regard it as absolutely distinct.

Fulgur stellatum n. s.

Plate 4, figure 9.

Miocene silex-beds of Ballast Pt., Tampa Bay, Florida.

Shell thin, attaining about eight whorls; nucleus large, smooth and swollen, of about two whorls; succeeding whorls encircled by a thin, round-edged keel, neatly divided in the early whorls into about a dozen even, subequal, triangular, flattened rays, with equal interspaces, stellate when viewed from above; the surface of the whorl behind the keel smooth, excavated moderately and rising at a low angle to the suture, which is not appressed, and is hidden under the shadow of the keel of the preceding whorl; on the last whorl in the adult the keel between the radii is less pronounced, but the flat spines retain much of the same character; in front of the keel in the young the whorl is sparsely spirally striated and somewhat constricted at its base; the adult has the periphery nearly smooth and the base of the whorl more rounded; the canal appears to be striated, very straight, rather stout, slightly callous, but not grooved; I find no trace of an infra-sutural ridge or any internal liræ. The adult appears to reach a length of 85 and a diameter of over 50 mm.

The adult specimen of this remarkable species is too imperfect to figure, though affording information for a diagnosis. I have figured a tip which shows the curious dish-like keel and swollen nucleus of the young. A fragment, including most of the canal, found with the adult, is referred to this species with some doubt. It is evidently a rare form, but offers very clear-cut characters to distinguish it from the other species.

Fulgur maximum Conrad.

Busycon maximus Conrad, Foss. of Tert. Form. U. S., cover of No. 2, pl. 48, fig. 1, May, 1840.

Busycon tritonis Conrad, Proc. Acad. Nat. Sci. Phila. 1862, pp. 561, 583; Am. Journ. Conch. iii. p. 265, pl. 20, fig. 2, 1867.

Fulgur maximus Gill, Am. Journ. Conch. iii. p. 146, 1867.

Busycon maximum Conrad, Am. Journ. Conch. iii. p. 184.

>*Fulgur maximus* Heilprin, Trans. Wagner Inst. i. p. 72.

? *Busycon filosum* Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 286; Am. Journ. Conch. iii. p. 266, pl. 21, fig. 7, 1867 (cf. Heilprin, Trans. Wagner Inst. i. p. 72).

Fulgur rapum Heilprin, *op. cit.* p. 71, 1887.

Miocene of Florida, in the upper bed at Alum Bluff; of Duplin Co., North Carolina; also at Wilmington, N. C.; Pliocene of South Carolina? at Darlington, where the exact horizon is doubtful and may be Miocene; Pliocene of the Caloosahatchie beds on the Caloosahatchie River, S. W. Florida, Willcox, Heilprin and Dall.

This is an interesting and variable form which may be divided into three varieties, after premising that, as is the case throughout the genus, the females have a wide patulous canal, while the canal in male specimens is much narrower and more cylindrical.

Var. *maximum* (Conrad). Spire short, sloping, with the suture at the shoulder; no keel or tubercles.

Var. *rapum* (Heilprin). Spire scalar, with the shoulder rounded, nodulous or with distant spines, but no continuous keel. *F. tritonis* is the extreme of this variety, with a little more sloping shoulder.

Var. *tudiculatum* Dall. Spire very low, base constricted, last whorl greatly inflated; shoulder rounded, without keel or tubercles in the adult, excavated somewhat in front of the suture, which is bordered by a tuberculate or wavy elevated band formed by the thickened margin of the whorl being laid over the tuberculated shoulder of the young shell; canal slender, rather long, the pillar with a rather thick callus, but not grooved. Lon. (about) 60; lat. 35 mm. (Upper bed at Alum Bluff.)

I have not seen the transition to *filosum* observed by Prof. Heilprin, and, except for his remarks, should have regarded that form from Conrad's figures and description as bearing to *F. contrarium* such a relation as *F. eliceans* bears to *F. perversum.*

Fulgur perversum Linné.

Murex perversus Linné, Syst. Nat., p. 1222, 1766.

Pyrula perversa Lamarck, An. s. Vert. vii. p. 137, 1822.

Fulgur contrarius Conrad, Am. Journ. Sci. 2d ser. xxxix. p. 387, 1840; Foss. Tert. Form. U. S., p. 82, pl. 45, fig. 11, 1845.

Pyrula Kieneri Philippi, Zeitschr. Mal. 1848, p. 98; Petit, Journ. de Conchyl. 1852, p. 145; Conrad, Am. Journ. Conch. iii. p. 184.

Busycon gibbosum Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 286.

Busycon perversum Tuomey & Holmes, Pleioc. Foss. S. Car., p. 145, pl. 29, fig. 3, 1856; Emmons, N. Car. Geol. Rep., p. 249, fig. 107, 1858; Conrad, Am. Journ. Conch. iii. p. 184, 1867.

Busycon adversarium Conrad, Proc. Acad. Nat. Sci. Phila. 1862, pp. 560, 584; Am. Journ. Conch. iii. pp. 184, 185, 1867.

Fulgur perversus Gill, Am. Journ. Conch. iii. p. 146, 1867.

Fulgur contrarius Gill, *op. cit.* p. 146; Heilprin, Trans. Wagn. Inst. i. p. 72, 1887; Leidy, *ibid.* ii. pp. 51–53, pl. ix., x., 1889.

Busycon (*Sycopsis*) ***contrarium*** Conrad, Am. Journ. Conch. iii. pp. 184, 266, pl. 23, fig. 1, 1867.

Miocene of North and South Carolina; Pliocene of South Carolina and of the Caloosahatchie beds, S. W. Florida; Post-Pliocene, North Carolina, South Carolina and Florida (Myakka River). Recent in the present fauna from Hatteras to the Gulf of Mexico. It was wrongly catalogued by Conrad under the Oligocene (A. J. C. iii. p. 184, 1867), probably by a typographical error.

Fulgur perversum extends from the Miocene of North Carolina through the Pliocene, as in South Carolina and Florida; the Post-Pliocene, North Carolina to Florida; and the existing fauna. The variety with whorls not spinose or tuberculated, especially the males, is *F. contrarium* Conrad, the fossil spinose form exactly like the recent shell in *F. adversarium* Conrad. Both forms are found recent, but among the fossils the smooth form, and among living shells the spiny form, are respectively most prevalent. I have examined authentic types of all three. The imperceptible stages by which one passes into another are well illustrated by the paper of Dr. Leidy and Mr. Willcox above cited. There is another variety, with an almost flat spire, found both recent and fossil. The varieties without spines are apt to have the spire a little more scalar than the spiny ones, but this is not invariable and, as with the other species referred to, the combinations are multitudinous.

Fulgur echinatum n. s.

Plate 9, figure 2.

Shell dextral, short, with a stout body and seven or eight whorls; nucleus small, smooth, of one and a half whorls, subsequent whorls with numerous subspinose tubercles at the shoulder, whence the shell rises evenly to the suture, where it is closely appressed below the preceding row of spines; there are a few faint spiral striæ on this space in the early whorls, but they soon become obsolete; the lines of growth are slightly irregular; in the half-grown or adult shell the spines become more prominent and slender, even more or less curved as in some murices; there is a second series of small, sharp, but shorter spines at or slightly in front of the periphery on the last whorl; these, in aged specimens, are sometimes twinned; there are seven or eight spines or double spines in each series in the adult on the last whorl; the body is rotund and somewhat constricted at the base; the canal moderately long, narrow, twisted and recurved; aperture pointed behind, ovate; with a thin callus on the pillar and body, and a simple, sharp outer lip without (as far as yet observed) any internal liræ; there is a slight callous ridge but no groove on the pillar near its anterior edge; the figured specimen (including the spines) measures 72 x 58 mm.; the spine near the outer lip is 11.5 mm. long. An adult specimen measures 117 x 80 mm.; the longest spire on this one is 8.0 mm. long. The shell is solid and heavy, though not ponderous.

Caloosahatchie beds on the Caloosahatchie and Shell Creek, collected by Mr. Willcox.

It is somewhat singular that, to a study which has resulted in the consolidation of so many nominal species, fortune should have added the opportunity of naming two species which must rank as the most distinct of any known. This may fairly be said of *F. stellatum*, which awaits better material to be adequately figured, but there is certainly no other species which shows so few links of relationship with the rest of the genus as the one now described. It is certainly the most elegant in form of any, and like *Turbinella* (*Vasum*) *horridum* stands alone in the group.

Among the forms not noticed above I regard as good species *Fulgur fusiforme* and *F. carinatum* Conrad from the Miocene of Maryland and Virginia. *F. coarctatum* Sowerby is a rare variety which bears to the recent *F. carica* such a relation as *F. rapum* Heilprin does to *F. maximum* Conrad.

I am not sure as to the nature of the relations between *F. carica* L. and *F. eliceans* Montfort. For the present I prefer to regard them as varieties, though they may eventually prove distinct.

From a cursory examination of the fossil forms of the American Tertiary which appear related to *Fulgur*, I have come to the conclusion that *Tudicla*, like *Fulgur*, is the terminal development of a process of evolution which started in geologic time from a stock much like *Levifusus* or *Bulbifusus*, and which in different faunal regions attained a slightly different result.

Mechanically, *Fulgur* by its obliquely grooved pillar in many species is analogous to those forms like *Fasciolaria* which have such plaits on the pillar, while *Tudicla*, with its raised pillar-lip and transverse ridge of callus following the rule for horizontally coiled gastropods, is analogous rather to *Turbinella* proper.

I may add that the supposed difference, upon which Conrad laid such stress, between the larval shells of *Sycotypus* and *Fulgur* is non-existent except as a pathological monstrosity.

SUBFAMILY FUSINÆ.

Genus **Melongena** Schumacher.

As far as one may judge from the literature and the specimens in the National collection, the genus *Melongena* appears suddenly in the American Tertiary in the guise of a large and well-developed species, *M. crassicornuta* Conrad, from the Vicksburg limestone or later Eocene. Subsequently (Proc. Acad. Nat. Sci. Phil. vi. p. 321, 1853) Conrad referred this to a genus of *Purpuridæ* consisting solely of *Fusus minax* Brander, *Pseudoliva* (*Monoceros*) *armigera* Conrad, and *Melongena crassicornuta*. This "genus" he called *Cornulina* (though it was on one occasion printed *Cornuliria*), and its type was the *Murex minax* of Brander, the *Fusus minax* of Deshayes and others, an Eocene fossil of France (Paris Basin) and England. The third species, *crassicornuta*, was doubtfully added to the list, as the characteristic part of the lip was broken away in the type and unique specimen figured by Conrad.

Cornulina was placed next to *Monoceros* (= *Acanthina*) by Conrad and separated from it by having several small teeth on the outer lip in front of the usual single tooth, and by having a rounded instead of a flattened pillar. As the species definitely referred to it were, first, *F. minax*, which is treated—though not specified—as the type; and, secondly, *Monoceros armigera* Conrad, which is precisely a tuberculated *Pseudoliva*: the permanence of the name depends on these two, especially the first, since they do not, in my opinion, belong together, neither does *Melongena crassicornuta* Conrad belong with either of the others.

It has been incorrectly stated by Tryon that *Cornulina* had not been characterized, as he seems to have wholly overlooked the publication in 1853 in the proceedings of his own society.

I see no reason whatever to doubt that *M. crassicornuta* is a true *Melongena*. It has stouter and relatively fewer spines than subsequent species, but no other difference.

The next species appears in the Lower Miocene, and is perhaps a descendant of *M. crassicornuta*.

Melongena sculpturata n. s.

Plate 8, figure 3.

Miocene of Ballast Point silex-beds, near Tampa, Florida; of the limerock immediately overlying the silex-beds, especially at the estate of Mr. Lapenotière,

N. E. from Tampa ; also on the Chipola River, one mile below Bailey's Ferry, West Florida.

This species, like the others, has a spiny and a smooth form, though the latter usually acquires a few spines when fully adult. The young smooth form has been figured, which will be comparable with the figure of *M. subcoronata* var. *aspinosa* (Pl. 9, fig. 6). The chief characters of this species are as follows:

Shell of eight or nine whorls, rather elongated, with rather sharp, elevated, incremental lines, crossed by sharp-edged spiral threads of varying strength, so as to give a rather rasp-like surface-sculpture. The species exhibits two varieties, of which the extremes differ greatly from one another, though connected by minute gradations when a sufficient series is studied.

M. sculpturata var. *sculpturata* Dall. In this form the whorls are somewhat imbricated at the suture and decline with a rather steep slope to the series of spines at the shoulder, which are triangular and compressed ; they number about eight on the last whorl ; on the base a similar series of five or six shorter spines often encircles the canal about one-third of the way from the siphonal fasciole to the series at the shoulder; siphonal fasciole strong, arcuate, sometimes imbricated, but not spiny ; aperture elongate, smooth inside ; pillar with a moderate callus, reflected anteriorly as far as the fasciole, but without any umbilical chink ; canal well defined, rather short and wide ; whorls coiled rather closely just in front of the posterior series of spines, so that the even slope of the spire is a prominent feature. The spirals are alternated, from one to three sharp secondary threads between every two primaries ; the earlier whorls have proportionately more spines than the later ones, as usual in this group. A young specimen measures, inclusive of 13 mm. of spines, 50 x 80 mm., the aperture being 60 mm. long. The adults, judging from fragments, will measure 160 mm. in length occasionally.

This form was found at Chipola and also possible fragments in the silex-beds, but quite rarely. It is more numerous in the *Cerithium* rock with *C. hillsboroensis* Heilprin.

Melongena sculpturata var. **turricula** Dall.

Plate 8, figure 3.

In this variety the surface-sculpture is retained, but instead of a series of spines at the shoulder we have an undulate or even a simple keel, while the anterior series of spines is absent, the slope of the shoulder more nearly approaches the horizontal, the axis of the shell being regarded as vertical, while the suture is simple and destitute of imbrications. The result of these changes is that the shell has a more turrited spire and a very different appearance from that of the type, with which it is nevertheless united by imperceptible gradations. The specimen figured had lost its tip, which has been supplied from another in which that part was entire. The total length of the figured specimen is about 60.0 mm., with a width of 32.0 mm.

This form was found only in the silex-beds, though further search would doubtless have revealed it at Chipola. I have seen specimens from the Miocene of South Carolina.

The form which succeeds *M. sculpturata* in the Pliocene has a smoother surface, a shorter and wider form, more spines, and more ribs on the early whorls. *M. sculpturata*, on the whole, would appear to stand about midway between the Eocene and Pliocene forms, as regards its superficial characters.

It may be noted that the typical *sculpturata* has spines almost identical in form with those of *Papillina dumosa* Conrad, from which the young may be distinguished by their small spiny apical whorls and their short and slightly curved canal.

Melongena subcoronata Heilprin.

Melongena subcoronata Heilprin, Trans. Wagner Inst. i. p. 70, pl. 1, figs. 3, 3 a, 1887.

Caloosahatchie beds, Willcox, Heilprin and Dall.

Melongena subcoronata var. **aspinosa** Dall.

Plate 9, figure 6.

Caloosahatchie beds, rare; Dall and Willcox.

In this variety, which is always of moderate size, while the young is exactly like the young of the typical form, the older whorls do not develop spines or tubercles, but have the whorls obscurely transversely ribbed, the spiral sculpture not being altered. It is probable, since none of the specimens I have seen are of the full size of completely adult specimens of the typical *subcoronata*, that this variety does ultimately develop one or two spines on the shoulder near the aperture on attaining maturity. The specimen figured measures 65 x 31 mm.

The variations of the species in this group have already been alluded to. This *subcoronata* varies in exactly the same way as the typical *M. corona*, but in a very large series I have found but one or two specimens of *subcoronata* which could be exactly matched from the series of *corona*, and these exceptional specimens were all immature. The fully adult *subcoronata* is larger than the largest *corona* I have ever seen, and has more solid spines. The spire resembles that of *corona*, if looked at from behind the apex, but on a side view the species would (when fully developed) be taken rather for *M. melongena* L. The suture is less imbricated than in *corona*, and there are fewer and less prominent spines on the anterior part of the shell, which is more frequently free from spines than the same area in *corona*. On the whole, I think the name might be retained conveniently, though doubtless the Post-Pliocene and living *Melongena corona* is the direct descendant of this Pliocene type. The adult *M. subcoronata* measures 100 by about 140 mm. I have not seen any fossils which seemed referable to *subcoronata* except from the Florida Pliocene. All the later ones are unmistakable *M. corona*.

Melongena corona Gmelin.

Murex corona Gmelin, Syst. Nat. 3552, 1768.

Melongena corona Tryon, Man. iii. p. 108, pl. 41, figs. 199-203, 1881.

Post-Pliocene of North Creek, Little Sarasota Bay; also of the Myakka or Miacca River of S. W. Florida (Willcox). It is a member of the recent fauna extending from the Florida Keys along the shores of the Gulf of Mexico, and southward to Yucatan and Guadeloupe Island, W. I.

The variety without spines and with a turrited spire, corresponding to variety *aspinosa* of *M. subcoronata* and variety *turricula* of *M. sculpturata*, is known as *M. Martiniana* Phil. There are two quite well-marked varieties of the spiny sort. One in which the spines are distant, strong and long, and stand out at right angles to the general surface, is found exclusively on rocky ground, especially the shoals frequented by the " raccoon " oyster. The other has the posterior series of spines curved inward at their tips toward the spire, the anterior series less prominent; the number of the spines is greater, and they are, of course, much closer set. This form is found on the mud and sand-beaches only, and the variety *Martiniana* is an extreme example of it. The correlation of the surface-characters with the character of the ground on which they live is direct and conspicuous. Of course, dead shells or stray individuals may occasionally be found out of their proper habitat, but this is to be expected, and does not invalidate the evidence of the great mass of living individuals.

The variety named *M. Belknapii* by Petit is a specimen of the southern form (which is, as usual, more neatly sculptured and brightly colored than northern specimens), which has the spines paired instead of single. This is an individual mutation rarely observed in most spiny Gastropods. I have frequently noted it in *Melongena*, *Fulgur*, etc., but it is an individual, not a racial or varietal character, in the sense in which those terms are usually employed.

Regarded as a descendant of *M. subcoronata*, this species is more spiny, or rather, in the analogous varieties, it has more prominent spines, its surface-sculpture is less prominent, and it is on the whole of smaller size. The largest specimen I have ever seen measured 130 x 80 mm., was thin and light, and almost destitute of spines on the shoulder, those on the base being wholly absent. Compared with the adult *subcoronata*, it is a smaller, much lighter and more slender shell, and of quite a different habit. The operculum does not differ essentially from that of *Fulgur* and *Fasciolaria*.

Melongena consors Sowerby.

Pyrula consors Sby., Geol. Journ. vi. p. 49, 1850.

Melongena melongena Gabb (*non* Linn), *op. cit.* p. 205, 1873.

Pyrula ? melongena Guppy, Quart. Journ. Geol. Soc. 1876, p. 523.

Miocene of Santo Domingo.

An examination of Gabb's specimens confirms me in the opinion that his consolidation of Sowerby's species with various others was ill-advised. Guppy had already expressed doubts on this point.

Genus SOLENOSTEIRA Dall.

Of the genus *Strepsidura*, established in 1840, the genus called *Siphonalia* by Adams, a quarter of a century later, appears to be merely a section or synonym. The type of *Strepsidura* is *Fusus ficulneus* Lamarck, which differs from the Japanese type, upon which *Siphonalia* was founded, only in height of spire, external ornamentation, and length of recurved canal, all characters not more than sectional in value. But to *Siphonalia* authors have added several puzzling shells, such as "*Siphonalia*" *Kellettii* Forbes (*Kellettia* of Bayle), which does not offer any serious characters which should separate it from *Chrysodomus*, as far as yet known. Another group, typified by "*Pyrula*" *anomala* Reeve, "*Siphonalia*" *pallida* (B. & S.) Cpr., and other allied forms, mostly from the western shores of Mexico and Central America, has been referred to *Rapana* by some writers, while Carpenter, Adams and others placed it with *Siphonalia* and Tryon united it with *Melongena*.

These shells normally have an operculum like *Fusus* or *Melongena*; they do not, therefore, belong with *Rapana*, which has a purpuroid operculum. They are certainly not to be united with *Chrysodomus*, as was done by H. & A. Adams. They are certainly not identical with *Strepsidura* or *Siphonalia* proper. It is highly probable that they are, as supposed by Tryon, related to *Melongena*. But *Melongena* is a very well-characterized, compact group of large littoral species, having much such a habitat in warm regions as *Purpura*, which they resemble in mode of life.

The group in question differs from them in its regularity of sculpture, absence of spines, smaller aperture in proportion to the whole length, small size of the species containing it, and the absence of the posterior sinus near the suture, which characterizes the true *Melongena* when adult. I propose, therefore, to separate the group above discriminated from *Melongena*, as a genus, hereafter to be reduced in rank if necessary, should more exhaustive researches show its relations to be those of a subgenus rather than a genus. The type will be *Solenosteira* (*Pyrula*) *anomala* Reeve, Conch. Icon., *Pyrula*, pl. viii. fig. 12, 1847.

This group is represented in the Caloosahatchie marls by a very elegant species.

Solenosteira Mengeana n. s.

Plate 9, figure 1.

Caloosahatchie Pliocene marls on the Caloosahatchie River and Shell Creek, S. W. Florida.

Shell with a small, smooth, bulbous nucleus of one and a half whorls, followed by about six sculptured, rapidly enlarging later whorls; the nucleus is usually lost with the first one or two following turns, so that the apex (as in our figure) seems somewhat blunt, but when perfect, though short, it is quite acute; sculpture of 12–15 transverse rounded ribs, beginning at or near the suture and continuing over the periphery, becoming obsolete on the base of the whorl; the incremental lines are also somewhat alternated in strength and quite distinct; the spiral sculpture consists of (on the last whorl ten or twelve) sharp, even ridges, which override the ribs and descend into the interspaces, and each of which is usually accompanied by a pair of very fine, sharp threads parallel to it in the separating grooves; the ridges are usually very even in strength, but on the canal vary, being sometimes weaker or even almost absent there; suture distinct, undulated by the ribs, not channelled; whorls full and rounded, the last constricted at the base; aperture rather elongated, differentiated from the canal; the throat strongly lirate, with 8–10 elevated threads ending a little way within the edge of the outer lip, which is crenulated by the sculpture; pillar simple, with a thin callus; canal narrow, deep, somewhat recurved; siphonal fasciole strong, enclosing with the reflected pillar a moderate, not very deep umbilical pit; specimens vary in relative stoutness; one, with the nucleus, measures 24 x 16 mm.; another, which has lost the nucleus, 25 x 18 mm.

This elegant little shell is named in honor of Capt. Menge, in charge of the dredging operations of the canal company, to whom Mr. Willcox in his collecting tour is indebted for numerous courtesies.

Solenosteira inornata n. s.

Molds in the *Cerithium* limerock, stated by Heilprin to underlie the silex-beds at Ballast Point (where I did not find any indication of it), and in the bed of the Hillsboro River above Tampa. Gutta-percha casts from these molds afford the material for the following description.

Shell with a rather elevated spire and six or seven rapidly enlarging whorls; nucleus small, apparently smooth, blunt, with about one turn; subsequent whorls spirally sculptured with fine, low, even threads with equal or wider interspaces, on the last whorl more or less alternated in strength; transverse sculpture of eight or nine rounded ribs, most prominent at the periphery, feebler in front of the suture, and on the last whorl not unlike those of *Latirus floridanus;* whorls strongly appressed at the suture and somewhat constricted in front of it and at the base; suture distinct, sometimes with a corded anterior margin; canal short, wide, stout, the posterior edge of the siphonal fasciole keeled; aperture ovate, outer lip arched forward, posterior commissure narrow; pillar smooth, reflected in front so as to nearly cover a moderate umbilical chink; canal wide, rather deep, spirally sculptured like the rest of the shell; the casts indicate that on the periphery of the whorls one of these threads may be a little more prominent than any of the rest. Approximate measurements 36 x 20 mm.

This is a modest-looking species, having, as far as specific characters go, much the same aspect as *Latirus floridanus* Heilprin.

The rock from which the casts were taken was collected by Mr. Willcox. There are no signs of any liræ in the throat, but the general form of the aperture and base lead me to refer it without much doubt to the present group.

Genus **ECPHORA** Conrad.

Ecphora Conrad, Proc. Acad. Nat. Sci. Phila. i. p. 310, Oct., 1843. Type *Fusus 4-costatus* Say.

? *Stenomphalus* Sandberger, Mainz. Tert. Beck., p. 222, 1853. Type *Fusus cancellatus* Thomæ, Sandberger, *op. cit.* pl. xvii. figs. 7, 7 a, 7 b.

This genus has been referred of late by Tryon and others to *Rapana*, the type of which is *R. bezoar* of the *Purpuridæ*. *Latiaxis*, which is only an exuberant development of species of *Coralliophila*,—which identical species, when of medium development, comprise the genus *Pseudomurex*,—has been placed next to it.

The remarkable development of the umbilical pit is the common character of these three diverse genera. This is, however, one of the purely mechanical characters which by the necessity of the case will characterize any spiral gastropod having a few wide whorls rolled on a nearly horizontal plane, and which possesses a deep, rather short, recurved canal, well differentiated from the aperture. It is impossible for such a shell to grow without forming such an umbilical pit. Consequently, it does not follow that shells having this feature are necessarily related. Other characters may show a relationship, but this one taken alone is not decisive.

My impression is that Say was probably right in referring his fossil to *Fusus*, as then understood, and I suspect his *Fusus quadricostatus*, the type of the genus *Ecphora*, to be related to *Chrysodomus*. Take a specimen of *C. decemcostatus*, about two inches long, and place it by the side of a young *Ecphora*. In the latter the revolving ridges are fewer in number and exaggerated in size, but their character is the same essentially. The nucleus of *Ecphora* is smaller, the whorls are more horizontally coiled, and the deep, narrow canal necessitates a flaring umbilical pit, which the wider, shallower, less recurved canal of the *Chrysodomus* does not more than suggest. Both shells have the translucent brown outer layer covering a white, opaque lining, both are without liræ in the throat, and all the general characters except the umbilicus are strikingly similar. The canal of the young *Ecphora* is nearly as long as the aperture behind it, and relatively longer than in the *Chrysodomus*, though in the adult fossil these relations have changed.

The European shell supposed to be an *Ecphora*, and named *Stenomphalus* by Sandberger, I have never seen. Its relations must remain doubtful until the matter has been re-examined in the light of modern research. It strongly resembles a *Rapana*.

Ecphora quadricostata Say.

Fusus quadricostatus Say, Journ. Acad. Nat. Sci. Phila. iv. p. 127, pl. vii. fig. 5, 1824.

Ecphora quadricostata Conrad, Proc. Acad. Nat. Sci. Phila. i. p. 310, 1843; Mioc. Foss., p. 84, pl. 48, fig. 2, 1845.

Miocene of Maryland, Virginia, the Carolinas, the upper bed at Alum Bluff, West Florida, and possibly the silex-beds at Ballast Point, Tampa Bay.

What *Gryphæa costata* is to the Cretaceous and *Venericardia planicostata* to the Eocene, this shell may be said to be to the Miocene of the Atlantic coast. That is to say, its presence in undisturbed strata is sufficient evidence of their age.

About twenty years ago Dr. R. E. C. Stearns collected on the shores of Tampa Bay and its arm, Hillsboro Bay, where the most noted exposure of the silex-beds occurs. Long Key is a mere dry expanse of sand thrown up by the waves and protecting Tampa Bay, but containing, as far as known, no solid rock of any sort. It lies between the sea and the southern part of Tampa Bay, off the Manatee River. On the shore of this key Dr. Stearns collected a fine, perfect specimen of *Ecphora*, now in the National Museum. It has much the appearance of the silex-bed fossils, which are washed out of the marl, drifted with the roots of trees undermined and carried away by storms, and spread rather widely like recent shells on the shores of Tampa Bay. The rocks older than the silex-beds of this vicinity are of a different, very yellow color, their fossils are represented almost wholly by molds, and if present are, as a rule, not silicified. At that day collectors had not invaded the region mentioned, and as there seems absolutely no outside source from whence the *Ecphora* might be derived, I feel justified in referring it to the marl of the silex-beds, though it was not actually taken out of the marl by Dr. Stearns. It could not have floated far, owing to its size and weight, for the surf outside of the bay is always heavy. The only alternative seems to be that it might have come down the Manatee River in flood-time, with some tree from the Rocky Bluff Miocene beds. But Miocene beds in which the shells are thus preserved are not known in this part of Florida, and the weight of probability seems to connect the specimen with the silex-beds, although a careful examination shows that it is not silicified.

Genus **FUSUS** Lamarck.

Subgenus **Papillina** Conrad, 1865.

Turrispira Conrad, Smithsonian Checklist Eocene Foss. U. S., p. 19, 1866.

Clavifusus Conrad (sp.).

Fusus (Papillina) dumosus Conrad.

Plate 10, figure 6a.

Strepsidura dumosa Conrad, Proc. Acad. Nat. Sci. Phila. vii. p. 262. Wailes, Geol. Miss., p. 289, pl. 17, figs. 10*a*, 10*b*, 1854. (Jackson group.)

Papillina mississippiensis Conrad, Am. Journ. Conch. i. p. 17, 1865.

Jackson group of Mississippi, Conrad. Vicksburg, Miss., Heilprin. Eocene nummulitic limestone of Richard's quarry, Ocala, Florida (as molds).

This is not a *Strepsidura*, and the reference to the *mississippiensis* is one of those blunders due to haste which are not uncommon in Mr. Conrad's work. The name *mississippiensis* lies just above, and was taken off instead of the right one to which the figure-references refer. I have examined the types of the several species. The first species of *Papillina* is a shell named by Conrad *Fusus altilis* (Tert. Foss., 2d ed., p. 43, pl. 18, fig. 16, 1835). The figure does not clearly show the character of the nucleus, but it is really like the others. As the species are arranged alphabetically, its standing first is unimportant. The second is *F. dumosus*, the last *P. papillatus*, which looks much like a *Tudicla*, but wants the raised inner lip and the strong angular ridge or plait on the columella in the genuine *Tudicla*. Beside these, on the same plate on which they are figured, are *Fusus protextus* (Fig. 7) and *salebrosus* (Fig. 13), the latter perhaps the young of the former, but all agreeing in the peculiarity of the nuclear whorls—a fact which I have confirmed by an examination of the type-specimens at Philadelphia. The genuine *Tudicla* has a small, few-whorled, swollen, irregularly coiled, smooth nucleus like that of *Columbaria*. The nucleus of *Papillina* is perfectly regular, smooth and very large, its visible surface turbinate or when more elevated somewhat like the upper whorls of a smooth *Strophia*. I regard the resemblance in shape to *Tudicla* in *P. papillata* as a purely external character and do not doubt that that species is more nearly related to the others I have mentioned, and which resemble *Tudicla* very slightly or not at all. The figure given is taken from a gutta-percha "squeeze" of a mold collected by Mr. Willcox at Richard's quarry, Ocala, Florida. The specimen is not spinous at the angles of the shoulder and consequently its appearance is more regular than the typical form of *dumosa*, but, as in *Melongena*, the spines are variable characters, and are often absent, or obsolete.

Subgenus **Fusus** s. s.

Fusus equalis Emmons.

F. equalis Emmons, Geol. Rep. N. Car., p. 250, fig. 111, 1858.
Neptunea equalis Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 560.

Cape Fear River Miocene, North Carolina (Emmons). Alum Bluff (upper bed), W. Florida; Burns.

This fine species appears to be rather common at the Alum Bluff locality.

Fusus Burnsii Dall.

Fusus sp. Conrad, Foss. Med. Tert., pl. 49, fig. 4, Jan., 1845.

Miocene of Virginia at Petersburg, etc., Willcox.

A fine specimen of this species under the name of *F. exilis* Conrad was received from Mr. Willcox. *F. exilis* Conrad was described and figured in his Foss. Shells of the Tert. Formations of the U. S., 1st edition, p. 17, fig.

2, plate 3, Oct., 1832. The same shell was figured on pl. 49 (fig. 1) of his Fossils of the Medial Tertiary, 1845. See Proc. Acad. Nat. Sci. Phila. 1862, p. 560, under *Neptunea exilis*. The shell figured by Tuomey & Holmes under the name of *Colus exilis* might be the young of *exilis*, or possibly of *Burnsii*, or a distinct species. The shell figured as *F. exilis* by Emmons (p. 561, fig. 111 a) is not *F. exilis*, but the figure is too poor to determine with certainty what it is. *F. Burnsii* is named in honor of Mr. Frank Burns, of the U. S. Geological Survey, to whose ability and energy as a collector of fossils in the Southern Tertiary I am greatly indebted.

F. Burnsii resembles *F. exilis*, but wants the ribs on the last whorl, which is fuller and rounder, while the earlier whorls are more acute. The spiral threads are minutely notched or serrated by impressed incremental lines on the upper whorls. It also resembles *F. equalis*, which is a more robust shell, with coarser sculpture, and built on a larger scale. There is some reason to believe that Mr. Conrad considered *F. Burnsii* as a variety of his *F. exilis*, from a MS. note in one of the books belonging to the late F. B. Meek, but if this was his opinion I cannot join in it. Prof. Meek has also recorded his opinion that the two were distinct.

Fusus ballista n. s.

Plate 8, figure 4.

Miocene silex-beds of Ballast Point, Tampa Bay, Florida, rare.

Shell of six or seven whorls, with about nine faint transverse ribs, crossed by low, weak spiral threads, with subequal interspaces; suture appressed, last whorl rather elongated; outer lip thin, simple; pillar slightly flexuous, smooth, with little evidence of a fasciole; canal rather short, narrow. Max. lon. of shell 26.0; lat. about 11.0 mm.

The spiral sculpture is often badly preserved or obsolete on the siliceous pseudomorphs as an incident of their mineralization. The specimen figured was kindly lent for the purpose by a gentleman who had collected it for his private collection. The species is represented by several rather imperfect specimens in the national collection.

Fusus caloosaensis Heilprin.

Fusus caloosaensis Heilprin, Trans. Wagner Inst. i. p. 68, pl. 1, fig. 1, 1887. Dall, Rep. Blake Gastr., p. 167, pl. 39, fig. 4, June, 1889.

Pliocene marls of the Caloosahatchie River and Shell Creek, Southwest Florida.

This interesting species, doubtless the Pliocene ancestor of *F. timessus* Dall, now living in the Gulf of Mexico, was illustrated in the original publication from an abnormally slender and exceptionally small specimen. I have not, in a large number which passed under my eyes, seen another specimen exactly according with the shell referred to. In my report on the Blake Gastropods, by an accident in making up the plates the figures of *F. timessus* and

F. caloosaensis were transposed so that the latter appears on the Blake plates instead of the former. I now add the figure of *F. timessus* (Plate 7, figure 6), which will be useful for comparison. The nucleus of *F. caloosaensis* is exactly like that of some Fasciolarias and is elegantly sculptured. Both the spire and canal seem to have been more than usually subject to injury and consequent distortion.

Fusus sp. indet.

A small, elegantly sculptured species of *Fusus*, something like *F. Meyeri* Aldrich, but with the whorls not keeled at the periphery and the ribs elevated at the shoulder, was noticed among the shells represented in the molds contained in the " *Cerithium* rock " of the Hillsboro River, Tampa. Only part of the lower whorl and the canal were preserved, so I have not thought it best to do more than note its presence there.

Fusus mississippiensis Conrad.

F. mississippiensis Conrad, Journ. Acad. Nat. Sci. Phila. i., 2d series, p. 117, pl. 11, fig. 34, 1848.

A silicified specimen of this species is included in a piece of rock collected by Mr. Willcox at Martin's Station, Marion Co., Florida.

Fusus? quinquespinus n. s.

Shell bearing a singular resemblance in many of its characters to *Papillina dumosa* and the young of the spiny form of *Melongena sculpturata*, and best described by comparison with them. It has not the apical whorls and large nucleus of *Papillina;* the whorls are not appressed at the suture as in *P. dumosa;* it has five spines instead of seven on the last whorl; the pillar wants the thick layer of callus, and it has a wider, shorter and more curved canal than *P. dumosa;* the peripheral spines are continued to the tip, which, in my best specimen, has lost the nucleus, which, however, was small. What remains has three and a half whorls, and there were originally at least five. It measures, including the spines, 35 x 21 mm. In other respects it closely resembles *P. dumosa*, and also the young of *Melongena sculpturata*, except in the slope of the upper part of the whorls. I am much puzzled by this singular fragment, which seems distinct from anything else, and for the present will call it *Fusus*, though I am not certain that mature specimens would indicate its place to be with *Fusus* proper.

It was collected by me at Ballast Point from the marl of the silex-beds, and impressions in the *Cerithium* limerock described by Heilprin, though not conclusive, indicate that it is represented also in that fauna.

Fusus (Chrysodomus?) nexilis n. s.

Plate 8, figure 4.

Shell small, with two nuclear and six subsequent whorls, transversely ribbed and spirally threaded; nuclear whorls at first smooth, normally coiled, the second gradually acquiring close-set, concavely arched, transverse riblets; subsequent whorls showing between the sutures about five strong threads, with wider interspaces, overrunning nine well-marked round ribs, extending from suture to suture; on the last whorl the ribs become more or less obscure, the spirals more numerous and less elevated, and the whorl shows a tendency to constriction in front of the suture; whorls rounded, suture appressed, undulated by the ribs; canal moderate, recurved, striated sparsely behind; aperture ovate, outer lip simple, sharp, without internal liræ; inner lip smooth, concave, not callous. Max. lon. of shell 12.0; of aperture 6.0; max. diam. of shell 5.0 mm.

Silex-beds at Ballast Point, rare.

The figure was drawn from a less perfect specimen than that from which the description was subsequently secured, and does not show the strength of the sculpture on the upper part of the spire, the curvature of the canal, or its constriction at the base as clearly as desirable. It is, however, very considerably magnified.

Genus **PISANIA** Bivona.

Subgenus **Tritonidea** Swainson.

Tritonidea pauper n. s.

Plate 4, figure 8 c.

Shell small, with one and a half smooth nuclear, and about five subsequent whorls; transverse sculpture of numerous (11–16) broad, close-set, low, rounded riblets, which become obsolete in front of the periphery, are slightly concave in the direction of growth, and on the spire extend from suture to suture; spiral sculpture, on the early whorls, of three primary cords, one near the suture, the other two near the periphery, between which finer ones are gradually intercalated; these override the riblets and, at first, become rather nodulous at the intersections, but on the last whorl the spirals have become more numerous and cover the whole whorl without nodulation, and generally alternate in strength; canal short, recurved; apertural varix well marked; aperture subovate, outer lip internally dentate, with three especially marked anterior teeth (not well shown in the figure); inner lip reflected, more or less granulous; pillar keeled at its anterior end; the whorls are moderately rounded and the suture very distinct. Max. lon. of shell 9.5; of aperture 5.0; max. lat. of shell 5.0 mm.

Miocene of Ballast Point, in the silex-beds, rare.

This pretty little species belongs to the group of which, among recent forms, *T. Orbignyi* Payr. is an example. The latter is both Mediterranean and Floridian, and this would indicate some antiquity for the race.

The figure, otherwise good, does not show well the nascent granulations on the pillar or the little teeth inside the outer lip, but the peculiar condition of the pseudomorph rendered it particularly difficult for the draughtsman to make out these characters.

Pisania (Tritonidea) auritula Link.

Nassa undosa tranquebarica Chemnitz (*ex parte*), Conch. Cab. iv. p. 35, pl. 123, figs. 1148, 1149 (only), 1780.

Nassaria auritula Link, Rostock Samml., p. 124, 1807.

Buccinum tranquebaricum Gmelin, Syst. Nat., p. 3491; Dillwyn, Cat. ii. p. 629, No. 100, 1817 (*ex parte*).

Buccinum coromandelianum Lamarck, An. s. Vert. vii. p. 271, 1822.

Cantharus ringens Tryon, Man. iii. p. 163, fig. 288, pl. 74; not of Reeve or Carpenter.

Cantharus coromandelianus Tryon, *l. c.*, *ex parte;* not of Lamarck.

Purpura tridentata Tuomey & Holmes, p. 137, pl. 28, fig. 9, 1856.

Pliocene of Black River, South Carolina; Caloosahatchie beds at Shell Creek and Punta Gorda, S. W. Florida, rare. Recent in the West Indies from Jamaica to the northern coast of Brazil, and westward to the Swan Islands.

This species has been alleged to come from the Coromandel coast, but I have never seen any recent specimens except from the West Indian region. It is much confused by Tryon with quite distinct forms from West America and elsewhere. The idea of uniting it with *T. ringens* appears absurd. The first binomial appellation referring solely to this species is that of Link. The name *Cantharus* has no standing in nomenclature, and should not be adopted.

This species in Pliocene times extended its range as far as South Carolina; the fossil Floridian specimens are finely grown and larger than the average of recent ones, but have the characteristics of the species unmistakable. I have not seen it from the Floridian Post-Pliocene, and its place in the Post-Pliocene and recent fauna has been filled by the allied, but sufficiently distinct, form named *T. tincta* by Conrad. The Punta Gorda fossil is noted by Mr. Willcox as from the upper layers of the Pliocene in what has been known to collectors as the *Venus cancellata* bed.

Lævibuccinum prorsum Conrad (+ *lineatum* Heilprin) of the Eocene of Wood's Bluff, Alabama, is a genuine *Pisania* of the typical sort, except that the subsutural callus is not drawn into a ridge. It may be considered as the forerunner of the genus. *Neptunea constricta* Aldrich also belongs in this vicinity. On the other hand, the species doubtfully referred to *Pisania* with the specific name of *dubia* by Mr. Aldrich, would seem to be more nearly related to *Urosalpinx*, like *Fusus trossulus* Conrad. *Pisania Claibornensis* Whitfield (1865), as pointed out by Mr. Aldrich, is not a *Pisania*, but is the young of *Ranella* (*Ranellina*) *Maclurei* Conrad, of which he gave a figure and name, but no description, in 1835. The young was both described and figured in 1841 by H. C. Lea (Sill. Journ. xl. p. 99, pl. 1, fig. 16) under the name of *Triton pyramidatum*. Lea's type is still preserved at Philadelphia. *Cantharus cumberlandianus* Gabb is a *Coralliophila*, and has nothing to do with *Cantharus* (= *Tritonidea*).

Genus **PHOS** Montfort.

Phos parvus var. **intricatus** Dall.

Triton parvus C. B. Adams, Contr. Conch., p. 59, 1850.

Phos intricatus Dall, Proc. U. S. Nat. Mus. vi. p. 325, pl. 10, fig. 9, 1883.

Pliocene beds of the Caloosahatchie.

Recent, in shallow water from Florida to Anguilla and along the eastern coast of Mexico.

The fossils are identical with the recent shells of the variety *intricatus*.

Phos sp. indet.

Miocene of Ballast Point, Tampa Bay in the silex-beds.

Imperfect specimens of a species of *Phos* have been collected by Mr. Burns at Ballast Point.

It has, on the spire, three, on the last whorl nine or ten, primary spirals, each pair with two or three much finer intercalary threads, crossing numerous (9–15) narrow, transverse riblets, with wider interspaces, which extend as far as the whorl; the primary spirals are slightly swollen at the intersections; the lines of growth are rather strong; the nucleus is smooth and two-whorled and there are five subsequent whorls, which are but moderately rounded; the suture is very distinct; the canal is short and twisted, with a marked fasciole; the outer lip thickened and sharply lirate inside; the pillar anteriorly keeled. Max. lon. of shell 10.5; of aperture 4.5; max. diam. of shell 4.5 mm.

The specimens of this species are all defective. It recalls in a general way the appearance of *Tritonidea pauper*, except that its transverse riblets are narrow and continued to the canal and that the shell is more acute, more slender and with a relatively longer spire in proportion to the last whorl.

To this genus belong *Buccitriton sagenum* Conrad (+ *Nassa cancellata* Lea) and *Nassa* or *Tritia mississippiensis* of Conrad, both of the Upper Eocene.

Genus **ENGINA** Gray.

Engina turbinella Kiener.

Ricinula turbinella Kiener, Mon. *Purpura*, p. 29, pl. 9, fig. 25.

Engina turbinella Tryon, Man. v. p. 192, pl. 62, figs. 38, 39.

Pliocene beds of the Caloosahatchie and Shell Creek. Recent in the West Indies, from Key West, Florida, southward to Jamaica, etc.

The fossils do not differ appreciably from the less compact variety of the recent shell. The most common form of the latter has the sutures less defined and the shoulder more sloping, but this is an unconstant character.

Genus **NASSARIA** Link.

Subgenus **Nassarina** Dall.

Nassarina glypta Bush.

Plate 9, figure 11.

Mangilia ? glypta Bush, Trans. Conn. Acad. vi. p. 461, pl. xlv. figs. 5, 5 a, 1885.

Nassarina glypta Dall, Blake Gastr., p. 181, 1889.

Pliocene beds of Shell Creek and the Caloosahatchie. Recent from Cape Hatteras to the Florida Keys in 14–63 fathoms.

The fossil form is identical with the recent one and as it has not been well figured I have added a good figure of the species.

From an examination of Gabb's type of *Metulella* I am inclined to think that group will eventually be classed in the vicinity of *Nassarina.*

FAMILY NASSIDÆ.

Genus **NASSA** Lamarck.

Nassa vibex Say.

Nassa vibex Say, Tryon, Am. Marine Conch., p. 34, pl. 7, figs. 52, 53, 1873.

Nassa vibex Say, Journ. Acad. Nat. Sci. Phila. ii. p. 231, 1822.

Nassa fretensis Perkins, Proc. B. S. N. H. 1869, p. 117.

Shell Creek and Caloosahatchie Pliocene beds, Heilprin, Dall and Willcox. Post-Pliocene of the Myakka River and North Creek. Recent Atlantic coast.

The species is not very abundant in the marl and varies very much in size, the largest specimen I have is larger than any recent specimen in the museum.

Nassa consensa Ravenel.

Nassa consensa Ravenel, Proc. Acad. Nat. Sci. Phila. 1861, p. 43; Tryon, Am. Mar. Conch., p. 35, 1873.

? Buccinum multilineatum Emmons, Rep. N. Car. Geol. Sur., p. 256, fig. 124, 1858; not of Marrat (1877).

Cape Fear marls, North Carolina ?, Caloosahatchie beds. Recent off the Atlantic coast of the United States from Hatteras to Florida.

Emmons' figure is rude, but characteristic. It differs chiefly from the recent and fossil *N. consensa* by being proportionally more elevated.

In the absence of any authentic specimen of Emmons' species and the above-mentioned difference, I forbear to unite them.

This species, both by color and fine, even sculpture, is now recognized and distinguished by most American naturalists, though we have not yet any very good figure of it. Its nearest relative is *N. ambigua* Mtg., which, as a rule, is smaller and much more coarsely sculptured.

Nassa ambigua Montagu var. **antillarum** Orbigny.

Buccinum ambiguum Mtg., Test. Brit., t. 9, fig. 7, 1803.
Nassa ambigua Tryon, Man. iv. p. 42, pl. 13, fig. 194, 1882.
Nassa antillarum Orbigny, Moll. Cuba, ii. p. 141, pl. xxiii. figs. 1–3, 1846.

Shell Creek and Caloosahatchie Pliocene beds. Recent Florida Keys and the Antilles.

This form is distinguished from the typical *N. ambigua* by its greater elevation, fewer ribs and sparser spiral sculpture. It is not very common in the marls.

Nassa bidentata Emmons.

Plate 9, fig. 9.

Buccinum bidentatum Emmons, Rep. N. Car. Geol. Sur., p. 257, fig. 126, 1858.

Shell stout, acute, with two smooth nuclear and five subsequent whorls; transverse sculpture (on the last whorl) of eleven or twelve stout, even, rounded, straight ribs, crossing the whorl, and faint incremental lines; spiral sculpture of (on the upper whorls two) six or seven stout, rounded, continuous threads, very slightly swollen as they cross the ribs; the anterior pair are closer together, the rest equi-distant from each other; beside these there are five or six close-set threads on the canal; on the upper whorls two of these threads are visible, and one is included in the suture; suture distinct, not channelled; terminal varix stout, thick, broader and posteriorly expanded at the suture, overrun by the spirals; aperture subovate; pillar-lip callous, with a raised border, smooth, with a sulcus at the posterior commissure of the mouth; outer lip with two strong teeth near the middle, and faint indications of one or two more anterior to the first pair; canal nearly closed, short, recurved and twisted; siphonal fasciole strong, the base of the whorl constricted behind it. Max. lon. of shell 6.5; max. lat. 3.75 mm.

Miocene marls of North Carolina, Emmons. Miocene of New Jersey at Shiloh, Burns. Shell Creek and Caloosahatchie Pliocene beds, abundant.

Emmons' specimen was not adult, but his figure agrees well with small specimens of the present species. It is not known in the recent state. The specimens vary somewhat in size, and in the closeness of their reticulation, as usual in this genus.

Nassa Lapenotierei n. s.

Plate 9, figure 8.

Shell small, elevated, slender, with three smooth nuclear and five subsequent whorls; transverse sculpture of (on the last whorl ten) elevated, rounded, even ribs with wider interspaces; more prominent near the suture, but crossing the whorl; there are also faint incremental striæ; spiral sculpture of (on the last whorl seven to nine) little-elevated bands with somewhat wider interspaces, subnodulous at their intersection with the ribs; between each pair of spiral bands on the last whorl are one to three finer, faint, secondary spirals; some of the specimens indicate that when alive the reticulation appeared white or pale-colored on a much darker ground; on the upper whorls three or four primary spirals are visible; whorls full and rounded, a little turrited; ribs apt to alternate at the suture, which is distinct, but not channelled; aperture small, shorter than one-third of the shell; outer lip with three teeth, the posterior about the middle of the lip and strongest, the other two anterior to it and successively weaker; pillar-lip with a raised margin on which in the fully adult are two or three transverse, short elevations like teeth; canal very short, the whorl constricted behind it. Max. lon. of shell 7.5; of aperture 2.0; max. lat. of shell 3.2 mm.

Rare in the Caloosahatchie beds.

Respectfully dedicated to Mr. F. J. Lapenotière, of Tampa, to whom we were much indebted for kind assistance in our work. This species recalls *N. acuta* Say, but has a different sculpture, is smaller and more cylindrical. It is much more slender than *N. bidentata* Emmons. It is not known in the recent state, or from other localities than the one above cited.

Nassa caloosaensis n. s.

Plate 9, figure 7.

Shell small, with three and a half normal and three smooth, turbiniform nuclear whorls; transverse sculpture of (on the last whorl ten) narrow, moderately elevated ribs, with wider interspaces, which completely cross the whorl and have a pointed nodule or angle at the shoulder; varix large and thick, other transverse sculpture, only of faint incremental lines; spiral sculpture of (on the last whorl seven or eight) sharply incised lines, of which two (the posterior fainter and sometimes absent) are in front of the suture and behind the shoulder, which last is formed by an ill-defined ridge connecting the angles of the ribs; on the base or anterior face of the shell are four of these lines rather close together and with their interspaces convex; between the posterior line and the shoulder are two widely separated similar lines; a deep sulcus divides the base from the short, twisted canal, which is externally covered with spiral threading; the suture is distinct, but not channelled, and somewhat wavy from the ribbing; the sides of the whorls are slightly flattened, the spire a little turrited; the aperture is short and broad, pointed behind; in the middle of the outer lip is one stout tooth with smaller liræ in front and, less often, behind it; the inner lip is more or less granulolirate, with a raised outer margin and a tooth on the body near the junction of the outer lip; canal short, narrow. Max. lon. of shell 4.2; max. lat. 2.4 mm.

Caloosahatchie marls, rare.

This neat little species is not approached very closely by any of the other American Tertiary or recent forms of *Nassa*.

An incidental examination of the types in the museum at Philadelphia shows that *Buccitriton altum* and *B. bellaliratus* Conrad belong to the genus

Nassa ; B. sagena Conrad is a *Phos.* *Phos texanus* appears to be a *Nassa* and not a *Phos.*

Tritia mississippiensis Conrad, from the Vicksburg, is a *Phos,* and so is *Nassa cancellata* Lea from the Claiborne sands, which is the same species as *B. sagenum* Conrad. A species closely allied to *Ilyanassa obsoleta,* if not, perhaps, identical, is found in the Miocene of Wilmington, North Carolina.

FAMILY COLUMBELLIDÆ.

Genus **COLUMBELLA** Lamarck.

Columbella rusticoides Heilprin.

C. rusticoides Heilprin, Trans. Wagner Inst. i. p. 81, pl. 8, fig. 9*, 1887.

Pliocene of the Caloosahatchie. Recent on the west coast of Florida, the Keys and Cuba.

This species is identical with the shell which has commonly been called *Columbella rustica* by American collectors, but which is hardly to be united specifically with the genuine *C. rustica* of the Mediterranean, though related to it. It is, therefore, to the American and not, as Prof. Heilprin supposed, the European species that the fossil is most nearly related.

The typical Columbellas, so far, are not known in America from strata earlier than the Pliocene. *C. mercatoria* L. is known from the Post-Pliocene of Costa Rica and Santo Domingo, and in the recent state extends northward to the Carolinas.

Subgenus **Anachis** Adams.

This is a much older group, if we may judge by American evidence, than the typical *Columbella.* With *Astyris* it extends to Mid-Eocene. *Dentiterebra prima* O. Meyer,* of which I have examined the type-specimen, is merely a small, rather elongated *Anachis,* and has no claims to separate generic distinction. It would fall in the section *Seminella* Pease. It dates from the Claiborne sands.

Strombina exilis Gabb (1873), from the Santo Domingo Miocene, is an *Anachis* and not a *Strombina.* I have examined the type-specimen.

The Pliocene has an abundance of species, several of which are found in the Caloosahatchie marls.

Anachis avara Say.

Anachis avara Say, Dall, Mar Moll. S. E. Coast U. S., p. 116, pl. 50, fig. 12, 1889.

Recent and Post-Pliocene from Massachusetts Bay to the Florida Keys.

Anachis avara var. **caloosaensis** Dall.

Pliocene of the Caloosahatchie and Shell Creek, Florida.

This form differs from the recent var. *avara* s. s. in having the suture appressed above the ends of the ribs so as to give it a somewhat marginated appearance and to angulate the aperture a little in front of the suture on the outer lip; the varix of the adult is more pronounced than in any specimen of the recent form I have seen, the liræ on the pillar and outer lip are stronger, the aperture narrower, the periphery of the last whorl distinctly flattened, and owing to the margination of the suture the spire has a slightly turrited appearance.

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* Proc. Acad. Nat. Sci. 1887, p. 52, pl. iii. fig. 2.

This varies in size and in the strength of the (usually 13–14) ribs, as the recent shells do, but I have not been able to find a single specimen which exactly reproduces the recent type in any of its numerous variations.

Anachis avara var. **amydra** Dall.

In this variety, which is less common, the ribs are obsolete or absent and represented only by a band of little knobs which coronate the whorl at the suture, which is not appressed; the spiral sculpture, always present, is in this variety more prominent owing to the absence of the ribs; the aperture is strongly lirate. This form is found with the preceding, and is nearest some of the mutations of *A. avara* var. *semiplicata* Stearns of the recent fauna.

Anachis camax n. s.

Plate 12, figure 3.

Shell slender, elevated, with two small, smooth (usually caducous) nuclear whorls and eight subsequent reticulated whorls; spire acute, with flattish sides; transverse sculpture of (on the last whorl 15) narrow, rounded ribs extending from suture to suture and (on the last whorl) over the periphery, becoming obsolete on the base, and, especially on the later whorls, with much wider interspaces; spiral sculpture of (between the sutures about 5) strong, flattish threads, most marked on the base and interspaces, feeble on the ribs and with subequal interspaces, except the first one in front of the suture, which is wider; whorls flattish, suture distinct; aperture rather narrow and long; canal short, pillar twisted; inner lip with a thin callus; outer lip not much thickened and with a few feeble liræ; lines of growth distinct. Max. lon. of shell 14.5; of aperture 5.0; max. diam. of shell 4.5 mm.

Pliocene marls of the Caloosahatchie and Shell Creek.

This form is longer and more slender and more regularly reticulated than any of the recent forms I am acquainted with. It is, perhaps, most like the strong-sculptured variety of *A. iontha* Ravenel, but much larger.

Anachis itbitoma n. s.

Plate 12, figure 6.

Shell small, slender, thin with a large, smooth, two-whorled nucleus and four subsequent whorls; transverse sculpture of numerous narrow, nearly straight, rounded riblets, reaching the sutures, but obsolete on the base, with subequal interspaces; spiral sculpture extremely fine and faint or none; whorls rounded slightly, suture distinct, but not appressed; base rounded; canal very short and rather wide; pillar twisted; aperture rather narrow; outer lip (in the adult ?) thin, simple. Max. lon. of shell 4.5; max. diam. 1.6 mm.

Rare in the Caloosahatchie marl.

The specimens of this interesting species are not quite mature. Doubtless the outer lip would be thickened and possibly lirate in the adult. It has the large nucleus which we observe in recent species of *Astyris* from rather deep water. I do not know any recent or fossil species to which it is very closely related.

Subgenus **Astyris** Adams.

This group is also quite ancient. *Surculites annosa*[*] Conrad, from the Shark River, N. J., older Eocene, has the appearance of an *Astyris* rather than of a *Pleurotoma* of any group, but I know it only by the figure. The oldest unquestionable *Astyris* I have actually identified from the specimens is *A. parva* H. C. Lea, from the Claiborne sands.[†] This has just about the same characters as the recent species. In the Miocene the species are larger and more numerous, but the group seems to have attained its maximum of development both in size and number of species in the existing fauna.

Astyris lunata Say.

Nassa lunata Say, Journ. Acad. Nat. Sci. Phila. v. p. 213, 1826.

Astyris lunata Dall, Proc. Bost. Soc. Nat. Hist. xiii. p. 242, 1870.

Pliocene of South Carolina and of the Caloosahatchie, Florida; Post-Pliocene of South Carolina, New York, the Myakka River and North Creek, West Florida. Living on the Atlantic Coast from Prince Edward's Island to the Florida Keys.

This widespread, variable, and well-known little species is represented by characteristic examples in the Caloosahatchie marl. In the writings of the earlier American paleontologists, *A. communis* Conr., though a much larger species, was often confounded with *A. lunata*.

Astyris profundi Dall.

Astyris profundi Dall, Blake Gastr., p. 192, pl. 35, fig. 3, 1889.

Pliocene of the Caloosahatchie beds and Shell Creek, S. W. Florida. Recent from North Carolina to Cuba in rather deep water.

This interesting species is represented by a large and a smaller form in the marls, which are 8.25 and 7.0 mm. long respectively, and do not differ by any other character. To the latter I have applied the varietal name of *minor*.

In the Proc. Acad. Nat. Sci. Phila. for 1862, p. 287, Mr. Conrad has given inadequate descriptions of three unfigured *Columbellidæ*. It would be impossible to recognize the species from these descriptions; there are no measurements, and they have not been figured. One of these, the *Astyris communis* of Conrad, which I have identified by specimens named by him, is probably the forerunner of *A. profundi* in the Miocene. This form was identified by Prof. Whitfield from the collections made by Capt. Frank Burns, of the U. S. Geological Survey, from the Miocene marls at Shiloh, New Jersey, and vicinity. The specimens from the Miocene of St. Mary's River, Maryland, and Yorktown, Va., are larger and better preserved, but differ only in size, which is rarely a specific character in this family. These forms, beside being larger than *A. profundi*, differ from it by having the whorl with a narrow, flat edge at right angles to the suture, which turriculates the whorls; the margin of the suture in *A. profundi* being smoothly and closely appressed. In *A. communis* the spire is less evenly acute, the pillar is more concave, the last whorl a little stouter proportionately, and the mouth somewhat wider on the average. Another species of *Astyris* found in the New Jersey marls is of the same general type as *A. communis*, but considerably more elevated and slender; it has been named *A. levis* by Prof. Whitfield.

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[*] Am. Journ. Conch. i. p. 213, pl. 21, fig. 9, 1865.

[†] Am. Journ. Sci. xl. p. 100, pl. 1, fig. 17, 1841; *Buccinum parvum* H. C. Lea (not Sowerby, 1844). With this appears to be synonymous *Columbella turricula* Whitfield, Am. Journ. Conch. i. p. 261, pl. 27, fig. 1, 1865 (not *C. turricula* Sowerby, 1832). By the figure, *Columbella mississippiensis* Meyer & Aldrich (Journ. Cincinnati Soc. Nat. Hist. ix. p. 43, pl. 2, fig. 17, July, 1886), is a well-characterized *Astyris*, and belongs to an horizon earlier than the Claiborne sands, which indicates that the development of the group must have begun considerably before that period.

A. communis, in some specimens, shows distinct traces of narrow color-bands extending across the whorls in a direction nearly parallel with the axis of the shell and slightly flexuous.

Astyris fusiformis Orbigny.

Colombella fusiformis Orbigny, Moll. Cuba, II., p. 136, pl. 21, figs. 25, 27, 1845.
Astyris fusiformis Dall, Blake Gastr., p. 191, 1889.

Pliocene marls of the Caloosahatchie and Shell Creek. Recent on the shores of South Florida and the eastern Antilles.

This species is not very common in the marls, but perfectly characteristic when found.

Astyris multilineata Dall.

A. multilineata Dall, Blake Gastr., p. 190, 1889.

Rare in the Pliocene marls of the Caloosahatchie. Recent off the eastern coast of the United States, south from Chesapeake Bay, in 9–200 fathoms.

The specimens have, of course, lost the color-bands so characteristic of the recent shell, but appear otherwise to agree perfectly with it.

Subgenus **Æsopus** Gould.

Æsopus Stearnsii Tryon.

Nitidella filosa Stearns (1873). Not *Æsopus filosus* Angas (1867).
Seminella Stearnsii Tryon, Moll. Conch. v. p. 179, 1882.
Æsopus Stearnsii Dall, Blake Gastr., p. 194, pl. 29, fig. 5.

In the Pliocene marls of the Caloosahatchie and living on the east coast of the United States from North Carolina to Florida.

Of this subgenus, Guppy (1874) describes a species from the Pliocene of Trinidad, under the name of *Columbella peculiaris*, but I cannot make his description agree with the present form.

Before leaving this family I may add that *Strombina exilis* of Gabb, from the Miocene of Santo Domingo, is an *Anachis*, and Guppy thinks it may be synonymous with the prior and unfigured *Columbella haitensis* Sowerby.

FAMILY MURICIDÆ.

Genus **MUREX** Linné.

Subgenus **Murex** s. s.

Murex messorius Sowerby.

M. messorius Reeve, Conch. Icon. *Murex*, fig. 90, 1845 ; Dall, Blake Gastr., p. 196, 1889 ; not of Tryon.

M. recurvirostris Gabb, Geol. Rep. St. Domingo, p. 201, 1873, not of Broderip.

Fossil in the Pliocene marls of the Caloosahatchie River and Alligator Creek, Florida, and also of Costa Rica. Post-Pliocene of Santo Domingo ; living in the Antilles and on the western coast of Florida and the Keys.

The specimens collected, though small, agree perfectly with recent specimens.

Murex chrysostoma Gray, var. **chipolana** Dall.

Lower Miocene of the Chipola River, West Florida, near Bailey's Ferry ; Ballast Pt. silex-beds (?).

The specimens from the Chipola River differ from the recent *M. chrysostoma* in being smaller than the average adult recent specimens, with a slightly shorter canal, from which the antecedent canal tends to divaricate, while in the typical *chrysostoma* it is usually continuous.

The anterior margin of the varices in the fossil also tends to be more spinose or to have the projecting points more produced than in the recent shell, though similarly situated and similar in number.

Murex mississippiensis Conrad.

M. mississippiensis Conrad, Journ. Acad. Nat. Sci. Phila., 2d series, vol. 1, p. 116, pl. xi. fig. 30, 1848.

M. tritonopsis Heilprin, Trans. Wagner Inst. i. p. 107, pl. 15, fig. 39, 1887.

Fossil in the Upper Eocene or Vicksburg beds of Mississippi ; the Lower Miocene of the Chipola River, West Florida, and of the silex-beds at Ballast Point, Tampa Bay, Florida.

The characters relied upon for the separation of *M. tritonopsis* are not confirmed by better preserved and more plentiful material. The nodes or transverse plications between the varices and the spiral sculpture, when perfectly preserved, are identical in the Eocene and Miocene specimens. It is observable that in many of the siliceous pseudomorphs the spiral or other fine sculpture is not reproduced in the silex as sharply and completely as it existed in the original fossil, which will not seem surprising to any one who has had experience in reproducing casts and molds *seriatim* without recourse to the original.

This species is beautifully preserved in the Chipola Miocene, though rare, but is more common, but poorly preserved, in the silex-beds.

Murex trophoniformis Heilprin.

M. trophoniformis Heilprin, Trans. Wagner Inst. i. p. 107, pl. 15, fig. 40, 1887.

Fossil in the Miocene of the Chipola River and the silex-beds of Ballast Point, Tampa Bay, Florida.

Subgenus **Chicoreus** Montfort.

Murex (Chicoreus) larvicosta Heilprin.

M. larvicosta Heilprin, *op. cit.* p. 106, pl. 15, fig. 37, 1887.

This species, so far, has been obtained only from the silex-beds. It had but six varices in the specimens I have seen.

Murex (Chicoreus) crispangula Heilprin.

M. crispangula Heilprin, *op. cit.* p. 107, pl. 15, fig. 38, 1887.

Silex-beds of Ballast Point. Only one specimen has been obtained so far, which is evidently related to the preceding species, having the same sculpture and number of varices, though less angular at the shoulder.

Murex (Chicoreus) brevifrons Lamarck.

Murex brevifrons Lam., An. sans Vert., ed. i., vol. vii. p. 161, 1822.
M. brevifrons Lam., var. *calcitrapa* Heilprin, *op. cit.* p. 68, 1887.

Pliocene of the Caloosahatchie beds, Florida; Post-Pliocene of the Antilles; living among the Antilles and on the eastern coast of the United States as far north as the Carolinas.

Murex (Chicoreus) rufus Lamarck.

M. rufus Lam., *op. cit.* p. 162, 1822.
M. sexcostata Emmons, Geol. N. Car., p. 248, fig. 106, 1858.

Fossil in the Miocene (?) of North Carolina (Emmons); the Pliocene of the Caloosahatchie beds and Alligator Creek, South Florida; the Post-Pliocene of the Antilles, and living in the existing fauna from off Cape Fear, N. Carolina, to the Florida Keys, and on the Gulf coast of Florida.

I fancy that the imperfect specimen of *M. rufus* described by Emmons, as well as his *M. globosus* (= *pomum* Gmelin), may have been Pliocene or Post-Pliocene and not Miocene, as he supposed. Small specimens of *M. rufus* are not uncommon in the Caloosahatchie marls, but the larger ones are rare and usually in bad condition.

Murex (**Chicoreus?**) **micromeris** n. s.

Plate 12, figure 12.

Rare in the Caloosahatchie Pliocene. Living in the Antilles (Jamaica and St. Thomas, U. S. Fish Com.).

Shell small, compact, with one and a half smooth nuclear and four subsequent sculptured whorls; transverse sculpture of (on the last whorl eight) rounded ribs continuous over the shell, with wider interspaces, and by incremental lines of which the edges are sometimes squamose, especially on the spirals; spiral sculpture of strong, elevated, granulose or slightly scaly threads with equal interspaces, strongest near the periphery and weaker in front of the suture; these number from three to six on the earlier whorls and on the last whorl are increased by intercalation; canal short, almost closed in front, with prominently squamose fasciole; aperture subcircular, with a thin, raised margin, smooth-edged on the inner or pillar-lip, crenulated by the sculpture and internally lirate on the opposite side; suture distinct, not channelled; Max. lon. of shell 7.5; max. diam. 4.5 mm.

The recent specimens are pink, or yellowish pink, and those that I have are slightly more slender than the single fossil specimen. I had regarded these as the young of *Murex rufus*, but having obtained a series of the latter, it was evident that this was erroneous.

There is a tendency on the earlier whorls toward a peripheral gap or wider interspace between the spirals in which, on the last whorl, an intercalary thread appears.

Murex (**Chicoreus?**) **Burnsii** Whitfield.

M. shilohensis Heilprin, var. *Burnsii* Whitfield (MS.), Miocene Gastr. N. Jersey, pl. 17. fig. 2.

Miocene marls of New Jersey, near Shiloh, and the Tampa silex-beds at Ballast Point, Tampa Bay, Florida.

The original specimen of *M. shilohensis* is in bad condition and suspiciously like *Muricidea spinulosa*, as far as it retains any characters (cf. *op. cit.* pl. 17, fig. 1). The truncated specimen, upon which Prof. Whitfield has founded his variety *Burnsii*, belongs, in my opinion, to a different species and subgenus. A young but entire specimen from the silex-beds completes the diagnosis sufficiently to confirm this view. It should be observed that so far as the young shell is concerned (and also the New Jersey specimen, though less markedly) it is the complete image of *Murex interserratus* Sby. of the same age. The last species is still living in the southeastern Antilles in deep water. It is, of course, impossible to say how much *M. Burnsii* would, in the adult state, differ from the living shell, and so it will be safest to leave the case in abeyance, awaiting fuller material.

Subgenus **Phyllonotus** Swainson.

Murex (**Phyllonotus**) **pomum** Gmelin.

Murex pomum Gmelin, Syst. Nat., p. 3527; Reeve, Conch. Icon. *Murex*, fig. 35, 1845; Dall, Blake Gastr., p. 198, 1889.

Murex oculatus Reeve. *op cit.* sp. 36, 1845.

Murex asperrimus (Lam.) Orbigny, Moll. Cuba, ii. p. 158, 1853.

Murex mexicanus Petit, Journ. de Conchyl. iii. p. 51, pl. ii. fig. 9, 1852.

Murex imperialis Swainson, Zool. Ill., 2d ser., ii. p. 67. Tryon, Man. ii. p. 101, pl. 23, fig. 206; Heilprin, Trans. Wagner Inst. i. p. 68, 1887.

Murex globosa Emmons, Geol. N. Car., p. 247, fig. 105*a*, 1858.

Murex globosus Conrad, Proc. Acad. Nat. Sci. Phila. xiv. p. 560, 1863; Meek, Checklist Mioc. Inv. Foss. N. Am., p. 22, 1864.

Murex pomiformis (Martini) Auctorum.

Fossil in the Miocene of N. Carolina (Emmons) and of Bowden, Jamaica; the Pliocene of the Caloosahatchie and Alligator Creek, Florida; Post-Pliocene of the Antilles; and living in the Antillean region and northward to North Carolina.

More evidence is required to confirm the presence of this species in the Carolinian Miocene, as reported by Emmons. It is possible that it is found there, but it has not been found by any one else, so far, in beds of that age, so far north. The Bowden specimens are identified with certainty.

Subgenus **Pteronotus** Swainson.

Murex (**Pteronotus**) **textilis** Gabb.

Plate 9, figure 4.

Murex textilis Gabb, Geol. Rep. Santo Domingo, p. 202, 1873; Guppy, Quart. Journ. Geol. Soc. xxxii. p. 522, pl. 29, fig. 1, 1876.

M. compactus Gabb, *op. cit.*

Miocene of Santo Domingo and Haiti; Pliocene marls of the Caloosahatchie and Shell Creek, South Florida.

This fine species, never having been adequately figured, is here illustrated from a Floridian specimen collected on the Caloosahatchie by the writer.

The group to which this species belongs is represented by three living species, of rather deep water, off the southeastern coast of the United States. In the fossil state it reaches a very respectable age, if, as seems probable, the *Murex Matthewsoni* Aldrich, from the Lower Eocene of Matthews' Landing, Alabama, should be referred to it. The latter is a young shell and closely related to *M.* (*Pteronotus*) *angelus* Aldrich, from the Red Bluff division of the Jackson group, if the figures are to be trusted. The Claiborne sands afford the *M.* (*Pteronotus*) *engonatus* Conrad, with which the *Fusus sexangulus* of the same author is synonymous.

The Pacific coast of the United States has a living species, which strongly recalls the *P. textilis*, in the *P. festivus* of Hinds, which is, however, considerably smaller.

Subgenus **Pterorhytis** Conrad.

Cerostoma Conrad, Journ. Acad. Nat. Sci. Phila. vii. p. 263, 1837.
Pterorytis Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 560.

This subgenus was first described by Conrad with the type *M.* (*C.*) *Nuttallii*, a recent species from California. Agassiz in his Nomenclator credits Latreille with a Lepidopterous genus of the same name of the date of 1802, which is probably the reason why Mr. Conrad proposed a new name in 1862 for his genus. As it is commonly admitted that naturalists should reject a name already used in another department of systematic zoology, it does not become necessary for us to investigate the standing of Latreille's name before adopting the second name of Conrad.

Murex (**Pterorhytis**) **umbrifer** Conrad.

Murex umbrifer Conrad, Foss. Sh. Tert. Form., p. 17, pl. 3, fig. 1, 1832; Emmons, Rep. Geol. N. Car., p. 247, fig. 104*a*, 1858.
M. (*Pterorhytis*) *umbrifer* Conrad, Am. Journ. Conch. iv. p. 64, pl. 5, fig. 7, 1868.
Cerostoma umbrifer Tuomey & Holmes, Pleioc. Fos. S. C., p. 141 (*not* pl. 28, fig. 14), 1856.
Not *Murex sexcostata* Emmons, *op. cit.* p. 248, fig. 106, as averred by Conrad, Proc. Acad. Nat. Sci. 1862, p. 560.

Miocene of Virginia at Yorktown and Day's Point on the James River (Conrad), and of North Carolina on the Cape Fear River (Emmons).

Two species have been confused by Mr. Conrad and others under this name. The original *umbrifer* has "six prominent recurved foliated ribs," according to Mr. Conrad's figures and subgeneric and specific diagnoses. With this has been confounded another species, *M.* (*P.*) *Conradi* Dall, which has but four ribs or varices, and still another which has six *spiral* ribs and only three varices, *M. sexcostata* Emmons (= *M. rufus* Lam.). Although neither species has yet been found in the Floridian Tertiary, it has seemed best to clear up the confusion here.

Murex (**Pterorhytis**) **Conradi** Dall.

Plate 12, figure 11.

Cerostoma umbrifer Tuomey & Holmes, Pleioc. Fos. S. C., expl. pl. 28, fig. 14, 1856; text, p. 141, *exclus.*

Miocene of St. Mary's River, Maryland (Clark), and of South Carolina at Goose Creek.

This fine species has, like most of the species of this genus, only four varices. The spire is much shorter than in *M. umbrifer* and the form of the varices is different. Tuomey and Holmes have figured a broken specimen under the name of *umbrifer*, though they give as diagnostic "six foliated reflected laminæ," when their specimen had only four; and this may have been in Conrad's mind when, in his last description of *umbrifer* in 1868, he allowed it "four lamelliform ribs," while his figure shows six!

Genus **EUPLEURA** Adams.

Eupleura caudata Say.

Ranella caudata Say, Journ. Acad. Nat. Sci. Phila. ii. p. 236, 1822; Am. Conch. v. pl. 48, 1832, Binney's ed., p. 200; Reeve, Conch. Icon., *Triton*, pl. xv. fig. 57; *ibid. Ranella*, expl. pl. vii. 1844.

Eupleura caudata Stm., Am. Journ. Conch. i. p. 58, pl. 8, fig. 5, 1865; Dall, Blake Gastr., p. 202, 1889; Bull. 37, U. S. Nat. Mus., p. 120, pl. 50, fig. 11, 1889.

Fossil in the Miocene (?) of North Carolina; the Pliocene of South Carolina and Florida; and the Post-Pliocene of most of the Atlantic coast. Living on the Atlantic coast from Cape Cod to the Florida Keys.

This species has been much confused, and the group to which it belongs, though containing but few species, presents as pretty a series of modifications in space and time as any evolutionist could wish to see. Exclusive of *E. pectinata*, of which I have only seen figures, and *Ranella pulchra* Gray, which belongs elsewhere, I recognize among the recent forms one well-established species on the Atlantic coast, with a subspecies or geographical race on the Gulf coast and some of the northern Antilles. On the Pacific coast we have two species, one of which is constant and well marked (the *E. nitida* Broderip), the other very variable and possessing a number of varieties which may be geographical or simply mutations, we are not yet in a position to decide which. *E. muriciformis* Broderip, which is the oldest name for the latter, has been referred to an unfigured "*Ranella clathrata*" of Gray, from the Atlantic, which is not only a more modern name than Broderip's, but the characters given for it are not compatible with the Pacific shell.

Although Say's name was published in 1822, it has been referred to this alleged *E. clathrata* Gray (1839) as a synonym!

The Atlantic form, the typical *caudata*, is found on the Atlantic coast from Cape Cod to the Florida Keys, and it is recognizable when adult by its smaller size, more cancellated sculpture, and by having five transverse riblets on the back of the last whorl between the two varices, and three in front. This is the form figured by Say, and which must retain the specific name. It is also fossil in the Post-Pliocene, if not also in the Pliocene, of the greater part of the Atlantic coast.

Eupleura caudata var. **sulcidentata** Dall.

Ranella clathrata "Gray" Calkins, Proc. Dav. Acad. Sci. 1878, p. 234. (Young specimens.)

Eupleura muriciformis Tryon, Man. 11, p. 158, *ex parte*, not of Broderip.

Ranella caudata Say, var. *Arango*, Faun. Cub. p. 214.

Gulf coast of Florida, shores of Cuba (Gundlach), living. Fossil in the Post-Pliocene of S. W. Florida.

The form figured in the Pliocene Fossils of South Carolina by Tuomey and Holmes is the typical *caudata*, as is that of the South Carolinian Post Pliocene. Calkins' specimens were young and looked much like the young of the Pacific coast species. The Pliocene fossils tend toward an intermediate character, as might be expected. I have seen no genuine *caudata* from the Miocene, though the shell figured by Emmons looks as if it was this species.

This variety is characterized by its thinner, more expanded and recurved varices, its generally whiter color, larger size, and has, in the adult, on the back, three intervarical, flattish, transverse ribs and two or three in front. The spire is rather more elevated than in the typical *caudata*, and, except on the varices, the spiral threads are often absent or obsolete. Young shells have more intervarical ribs than adults. In the Am. Marine Conchology Mr. Tryon, by some oversight, refers to the synonymy of *E. caudata* a *Fusus pyruloides* of De Kay, which appears to have been founded on an immature *Melongena*. It is possible he meant to write *Fusus imbricatus* De Kay, which is described on the same page as the other, and figured on the same plate. This figure somewhat resembles a young *Eupleura*, but from the description one would be disposed rather to refer it to an immature *Urosalpinx*.

Eupleura muriciformis Broderip.

Ranella muriciformis Brod., Proc. Zool. Soc. Lond., p. 179, 1832; Reeve, Conch. Icon., *Ranella*, pl. vii. fig. 34, 1844. (Montija Bay, W. Columbia.)

Ranella plicata Reeve, Proc. Zool. Soc., p. 138, 1844; Conch. Icon., *Ranella*, pl. vii. fig. 33, July, 1844.

Ranella triquetra Reeve, P. Z. S., 1844, p. 139; Conch. Icon., *Ranella*, pl. vii. fig. 41, 1844. (San Diego, Nuttall.)

Living from Venezuela to California on the west coast of America. Fossil in the Post-Pliocene of San Diego, California; of the Pacific coast of Lower California and of the head of the Gulf of California.

This species is entirely distinct from the *F. nitida* Broderip of the same region, and I have seen no connecting links with *E. pectinata* Hinds, which has been referred to its synonymy.*

There are three varieties in the recent material belonging to this species which I have examined.

The typical *E. muriciformis* has been repeatedly figured. The *R. triquetra* Reeve is a large specimen with the lip immature; the *R. plicata* of the same author is evidently an individual of the same species which has met with some accident, resulting in the shortening of the canal. The U. S. Fish Commission has dredged a fine series of *E. muriciformis* in the vicinity of Cerros Island, Lower California. The adult has the following characters:

On the last whorl there are three strong knobs between the varices on each side; there is a thin, webbed varix with six primary spines, all recurved and deeply grooved in front; within the aperture there is a dentiform callus on the outer lip between every pair of spines and one on each side of the sutural commissure; the spine at the shoulder is much the longest, but the second spine, counting forward, is the one corresponding to the axis of the intervarical nodes; the web between the shoulder-spine and the suture is bent forward; the spirals corresponding to the spines are very coarse, but not much elevated, and become stronger anteriorly as the spines diminish in strength and length.

The variety *unispinosa* was collected by Rich at Mazatlan. It has a thick varix, hardly webbed, with only one short, recurved spine, which is at the shoulder; a much recurved canal; a subtriangular section; and, owing to the absence of webbing and spines, appears especially slender. This is the form which in my report on the Blake Gastropods (A, p. 203) was contrasted with the typical *E. caudata.*

Lastly, at the head of the Gulf of California, near the estuary of the Colorado River, is found, both recent and in the Post-Pliocene of the vicinity, a variety which may be called *limata*, in which the intervarical nodes are obsolete; the whole surface nearly smooth; there are but two or three varices in all, and they are narrow and not prominent. This variety reaches a length of 40 and a width of 18.5 mm.

I have gone into details with regard to these shells, which come from another region than that of which this paper professes to treat, because it is evident that all these forms may be traced to an original late Eocene or early Miocene stock; and until a clear understanding is had of the recent branches, as far as known, the amount of divergency between the Miocene and the recent species cannot well be estimated.

The first suggestion of *Eupleura* of which I have been able to find traces is offered by Conrad's *Triton mississippiensis* (Journ. Acad. Nat. Sci., 2d ser., 1, p. 118, pl. 11, fig. 42, *not* 41, as printed), from the Vicksburg Eocene. In the Middle Miocene (upper bed) at Alum Bluff on the Chattahoochee River, Florida, a few specimens of a genuine Miocene *Eupleura* were collected by Mr. Burns. The *E. caudata* was referred by Conrad to the Miocene on the testimony of Emmons, and Conrad's erroneous supposition that *all* Tuomey and Holmes's Pliocene was really Miocene. My own impression is that the Eupleuras from both the Carolinas will prove to be Pliocene.

Eupleura miocenica n. s.

Plate 12, figure 9.

Shell of moderate size, six-whorled beside the (lost) nucleus; spiral sculpture of (on the last whorl about nine) large, feeble, revolving, flattened threads, with much wider interspaces and a very fine, often obsolete, spiral striation covering the surface; transverse sculpture of about eight stout, not very sharply defined, moderately elevated ribs, which begin at the shoulder and extend over the whorl, disappearing near the canal; the spirals overrun but do not nodulate them; the last whorl has two varices, thickened more prominently than the ribs, but not sharp-edged or spiny except for a single blunt point occasionally developed at the shoulder; the primary spirals exist on the anterior face of the last varix as elevated ridges crossed by sharp incremental lines and not as grooves, as in the more modern species; there are three ribs in front and four behind between the varices; canal not long, slightly recurved; aperture elongate, pointed before and behind; inner lip elevated, with a smooth edge, the surface slightly granulated in old specimens; body callous, with a subsutural ridge; outer lip with six teeth in front of the shoulder-angle; whorls rather full, appressed to the suture and undulated by it, rising at the varices, somewhat constricted in front of the suture, the excavation extending to the shoulder; spire rather short; early whorls smoother, with the ribs more prominent. Max. lon. of shell 29.0; of aperture and canal 20.0; max. lat. of shell 14.5; of aperture 5.5 mm.

Fossil in the upper bed at Alum Bluff, Florida, and (var. *intermedia*) very rare in the Caloosahatchie Pliocene.

This form is immediately distinguishable from the more modern ones by its smoother surface, less prominent varices, and especially by the way in which the whorl is constricted and appressed in front of the suture, which is thus made less even and less obvious. The fine secondary striation and the absence of any sharp edges are notable features.

There is a marked change between the Miocene form and its representative in the Caloosahatchie Pliocene. The high, appressed, smooth shoulder is shorter, and its slope at a greater angle with the axis. There are no sharp edges, and the specimens I have seen practically have but one varix. The spirals are more numerous and the secondary ones coarser; the transverse ribs more numerous, reaching ten beside the varix. The shell is almost exactly intermediate between the Miocene species and the true *caudata* of the more northern Pliocene and recent fauna. For this variety I propose the name of *intermedia*.

Simultaneously with the above modification of the ancient stock, we find the present southern variety *sulcidentata* present in the marls; so the condition which in *intermedia* preserved the rounded sculpture, was not unfavorable to the development of sharp laminæ in others. Perhaps the difference was really one of local habitat, as we find at present between the smoother and the spinose *Melongena*—a surmise which the condition of the marl-beds does not permit us to verify or reject by observation.

Genus **UROSALPINX** Stimpson.

As *Eupleura* resembles a *Pteronotus* with irregular and finally opposite varices, so *Urosalpinx* may be compared to a *Eupleura* in which the varices have become obscure or absent. The other differences are not of great importance. *Urosalpinx tampaensis* has been regarded as an aberrant *Eupleura* by more than one good conchologist.

The initiation of this group is not yet definitely determined. *Fusus pearlensis* and *Pisania dubia* Aldrich of the Upper Eocene have much the aspect of this group. *Murex simplex* var. *aspinosa* (sic) Meyer is not a *Murex*, has no connection with Mr. Aldrich's *M. simplex*, and is almost without doubt a *Urosalpinx;* if indeed it be not an elongated variety of *U. trossulus* Conrad. *Murex angulatus* Meyer might be a young *Eupleura* or *Urosalpinx;* but neither the description nor the figure is sufficient to determine its generic place; and when we consider the singular blunders into which this gentleman has fallen on various occasions, we cannot regard his opinion as sufficiently decisive on such a point.

U. cinereus Say, a very common east-coast species, is referred by Say and Conrad to the Miocene, but it is probable these writers then referred to the very closely allied form described later by Conrad as *Fusus trossulus.* It is uncertain whether the *U. cinereus* of Tuomey and Holmes is the typical *cinereus* or *U. trossulus. U. cinereus* is not among our collections from the Pliocene marls of Florida, but there seems to be little doubt that it is found in the Post-Pliocene of much of the Atlantic coast.

Urosalpinx perrugutus Conrad.

Fusus perrugatus Conrad, Am. Journ. Sci., n. ser., ii. p. 397, 1846.

Urosalpinx perrugatus Dall, Blake Gastr., pp. 212, 214, 1889.

Fossil in the Pliocene marls of Shell Creek, Florida, and the Upper Pliocene of the Myakka River in the same region. Living on the west coast of Florida from Cedar Keys to Key West.

Some specimens of this shell have a minutely imbricated sculpture on the spirals, like that usually characteristic of *Coralliophila.*

Urosalpinx trossulus Conrad.

Plate 7, figure 12.

Fusus trossulus Conrad, Foss. Tert. Form., p. 18, pl. 3, fig. 5, 1832; Foss. Med. Tert., 1st ed., p. 84, pl. 48, fig. 6; 2d ed., p. 89, 1845.

Neptunea trossula Conr., Proc. Acad. Nat. Sci. Phila., Dec., 1862, p. 560.

Siphonalia trossula Conr., Am. Journ. Conch. iv. p. 249, 1869.

Miocene of James River, Virginia, near Smithfield, and of Maryland; Pliocene of the Caloosahatchie beds and Shell Creek, S. W. Florida.

This species is very variable; the typical form is rather more elongated than the specimen figured, which is an especially blunt and short variety. In the type-specimens of Conrad, which are still preserved, the sculpture is of rather broad primary spirals with a single, much narrower, secondary thread between each pair and two extremely fine tertiary spiral lines, one on each side of the secondary. The faint transverse riblets are subequal, regular and separated by about equally wide interspaces; the suture, though distinct, is not deep and the whorls are rather compact. The primary spirals are undulated, but not granular, and the granulations on the others are inconspicuous. In one of the Pliocene forms (which may be called variety *subsidus*) the spirals have become subequal, narrow and granulous, with more distinct interspaces, the whorls are less compact, and the transverse ribs on the last whorl or two are sparse, irregular, and obsolete or nearly so. The sculpture of this variety is very elegant; it appears to be confined to the Pliocene, and has been found both on the Caloosahatchie and Shell Creek. It is connected by intermediate varieties with the typical form.

This species is neither a *Neptunea* (= *Chrysodomus*) nor a *Siphonalia* (= *Strepsidura*). It is not a typical *Fusus*, of course, but on comparison with our recent species of *Urosalpinx*, it is at once seen to have all their characters, and I have no hesitation in referring it to that genus.

Genus **MURICIDEA** Swainson.

Muricidea spinulosa Heilprin.

Plate 8, figure 9.

Murex spinulosa Heilprin, Trans. Wagner Inst. i. p. 1c8, pl. 15, fig. 41, 1887.

Fossil in the Miocene of the Ballast Point silex-beds, Tampa Bay, and of the Chipola beds, one mile west from the Chipola River, West Florida, at Bailey's Ferry.

The original specimen having been inadequately figured, I have thought best to give a second illustration of it. This species is quite closely related to the type of *Muricidea*, *M. hexagona*, but sufficiently distinct.

A second species probably of *Muricidea* was found at the same locality, but the single specimen seemed hardly well enough preserved to describe. It is, however, clearly distinct from any others yet described from this horizon, and appears to resemble *M. cristatus* Brocchi rather closely.

Muricidea floridana Conrad.

Urosalpinx floridana Conrad, Am. Journ. Conch. v. p. 106, pl. xii. fig. 4, 1869.

Muricidea floridana Dall, Proc. U. S. Nat. Mus. 1883, p. 326; Blake Gastr., p. 212, 1889.

Fossil in the Pliocene marls of the Caloosahatchie and Shell Creek.

One of the specimens shows a considerably more slender shell than the average of this species, and is more constricted behind the shoulder, with a smaller umbilical chink. At first sight it would be regarded as a distinct species. It measures 29 x 13 mm., when the ordinary form measures 29 x 16 mm. It may be called var. *attenuata*.

Muricidea multangula Philippi.

Fusus multangulus Phil., Zeitschr. f. Mal. v. p. 25, 1849.

Muricidea multangula Dall, Blake Gastr., p. 213, 1889.

Fossil in the Caloosahatchie and Shell Creek Pliocene marls; the later Pliocene of the Myakka River, Florida; the Post-Pliocene of the same region; and living on the eastern coast of North America from Cape Fear to Yucatan, together with the Antilles.

This very elegant species, owing to the neat and clean-cut spiral sculpture, is almost as handsome in the fossil state as it is in the recent condition.

Genus **OCINEBRA** Leach.

Subgenus **Favartia** Fischer.

The subgenus or section *Favartia* probably takes its rise in the Eocene. *Murex simplex* Aldrich (1886, not Philippi, 1847) has much the appearance of an *Ocinebra* from the figure, but I have not seen specimens. The so-called variety *aspinosa* of Meyer, belongs to a different group, and has nothing to do with the original *simplex*, if the figures can be relied on. *M. simplex* is from the Upper Eocene (Vicksburg); *M. Burnsii* from the Lower Miocene (New Jersey), while the species here referred to are of Pliocene age.

Ocinebra (**intermedia** Adams var.?) **alta** Dall.

? *Murex intermedius* C. B. Adams, Contr. to Conch., p. 60, 1850; not of Tryon.
Favartia intermedia Dall, Blake Gastr., p. 211, 1889.

Living from North Carolina to the Antilles and Bermuda. Fossil (the variety) in the Pliocene marls of the Caloosahatchie and Shell Creek, Florida.

	Tot. alt.	Alt. last whorl.	Max. diameter.	
O. cellulosa	25	17–14	15	8 varices
O. var. *alta* . . .	24	16–12	12	6 "
O. intermedia	20	13–10	10	6 "

It will be observed by the above table, which gives the relative proportions* of the three shells, that our fossil (while having the same number of varices as the much more slender *O. intermedia*) is intermediate between the two recent species in its proportions, though in other respects agreeing with them. The recent forms, of which I have been able to study a rather full series, seem to be very constant as regards form, and the very few specimens of the fossil I have seen are also constant. If this constancy is preserved in all the fossils from the Florida Pliocene, this form will have specific rank, in which case it may take the name of *O. alta*; but, considering the very limited material, I prefer for the present to regard it as a variety of *intermedia*, with which it agrees in many of its characters.

Ocinebra cellulosa Conrad.

Murex cellulosa Conrad, Proc. Acad. Nat. Sci. Phila. iii. p. 25, 1846.
Ocenebra nuceus Mörch (1850), Cat. Yoldi, p. 95, 1852.
Favartia cellulosa Dall, Blake Gastr., p. 210, pl. xvi. fig. 1, 1889.

Pliocene marls of the Caloosahatchie.

Among the young specimens collected from the washed and sifted marl two species are represented. The first is *O. alta*; the other (of which no adult was collected) resembles exactly the young of *O. cellulosa* of the same size. I therefore refer it to that species until more material can be examined. It is not impossible, however, that they may prove to be the young of *Murex Burnsii* Whitfield, the systematic place of which is uncertain, with the probabilities in favor of its proving to be a *Favartia.*

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* The two numbers in the second column refer to the distance from the suture behind the beginning of the last whorl and from that behind the aperture, respectively, in an axial direction to the anterior end of the canal.

Genus **TYPHIS** Montfort.

This genus, though never very numerous in species, is of a respectable antiquity, some having been described from the Cretaceous period.

The oldest American species is *T. antiquus* Gabb, described from the transition beds of the Chico-Tejon series in California, about corresponding to the Ripley sands of Alabama. It is a fully developed *Typhis,* and the genus must have originated at a still earlier period. In Mid-Eocene we have the *T. gracilis* of the Claiborne sands, and the Upper Eocene Vicksburg beds afford the *T. curvirostratus* Conrad.

In the earlier Miocene we have *T. alatus* Sby. of the Haitian Miocene, which, according to Guppy, persists into the Pliocene of Trinidad; and its variety *T. obesus* Gabb, with a shorter spire and wider varices. There are also *T. acuticosta* Conrad of the Miocene of Maryland, and *T. linguiferus* Dall of the Chipola beds. The Pliocene affords the *T. floridanus.* The Post-Pliocene has not offered any species of *Typhis* as yet; while in the present fauna, unless *T. expansus* Sowerby, described without habitat, be West Indian, there is no species of typical *Typhis* to be found. All the foregoing have four varices and the tubes are situated between the varices. There are two recent forms in the region: *T. longicornis* Dall, which is a *Trubatsa,* with the tube and varix fused, but the other characters of *Typhis;* and *T. cancellatus* Sowerby, which is like a rude, small, three-varixed *Cerostoma* with a tubular spine in the shoulder-angle of the varix and no tooth at the aperture. In this case the tube is formed at the same time as the varix, while in *Trubatsa* the tube is formed first and the varix afterward. The group represented by *T. cancellatus* may take the name of *Pterotyphis,* in a subgeneric sense, that being one of three or four names imposed upon it at the same time by the same gentleman, and based on varietal forms of the same species, according to Tryon.

Typhis alatus Sowerby, var. **obesus** Gabb.

Typhis alatus Sby., Geol. Journ. vi. p. 48, pl. x. fig. 4, 1850.

T. obesus Gabb, Geol. Santo Dom., p. 203, 1873.

T. alatus var., Guppy, Quart. Journ. Geol. Soc., Nov., 1876, p. 522.

Miocene of Haiti, Jamaica, and of the Chipola beds, near Bailey's Ferry, Chipola River, W. Florida. Pliocene of Trinidad (Guppy).

A single specimen was collected by Mr. Burns at Chipola which differs from *T. alatus* in the manner described by Mr. Gabb. It is the broadest and shortest of our fossil species.

Typhis linguiferus n. s.

Plate 12, figure 7.

Miocene beds on Ten-Mile Creek, near the Chipola River, West Florida, Burns, one specimen.

Shell with two laxly-coiled, polished, peripherally-keeled nuclear whorls and six subsequent whorls; surface polished; transverse sculpture of (on each whorl four) strong, thick, rounded varices, which gradually increase from in front backward, each being largest at the shoulder, where it is produced axially into a linguiform, rather pointed spine, between which and the suture the varix is depressed, then rises against the preceding whorl, where it is expanded and appressed; the spines are bent inward and to some extent backward, the varix is strongly marked by the incremental lines and is linked to the tube, which precedes it by a little elevated ridge, but there is no similar connection with the succeeding tube; the ends of these spines are generally broken and they then appear hollow for a short distance, but the spines are not pervious and have no connection with the interior of the shell; the tubes are moderately large and, instead of conforming to the curves of the varices, they curve upward, outward, a little backward and a little downward at last, though often broken; from the base of each tube a narrow ridge extends forward in harmony with the incremental lines, and behind this ridge is perceptible the mark of an old resting-stage; suture appressed and undulated by the sculpture; between the suture and the shoulder the whorl is somewhat excavated; other spiral sculpture only of a few irregular lines near the periphery, which give the surface a malleated appearance, but are not elevated enough to be termed threads or form continuous ridges; the roundness of the varices is not interrupted by them; as there are four varices to a whorl, there are usually three old canals discernible beside the one in use; there is no umbilical chink; the canal is wholly closed, slender and attenuated; the aperture small, subovate and simple with an elevated rim. Max. lon. of shell 15.0; diam. 7.2 mm.

This species most nearly approaches *T. curvirostratus* of the Upper Eocene, but is much more slender, smaller, and more elegant, while the Eocene form has at the shoulder only a short, obtuse spine, and the tube is much closer to its succeeding varix than to the preceding one; while in the present form the tube is midway or, if anything, a little more distant from the succeeding varix.

Typhis floridanus Dall.

Plate 9, figure 5.

Typhis floridanus Dall, Rep. Blake Gastr., p. 216, June, 1889.

Pliocene beds of the Caloosahatchie, Dall and Willcox.

Shell of five or six whorls exclusive of the nucleus; spire short; varices on each whorl four, expanded, rather thin and sharp-edged, the whorl between flattish; at the shoulder the varix is produced into a slender twisted spine, not pervious, but with its distal end open and rarely perfect, turned toward the axis; whorl behind the shoulder irregularly flattened, appressed, but not much expanded at the suture; from the spine at the shoulder to the whorl behind the varix is sometimes filled in by a thin shelly plate, and sometimes the plate is absent or obsolete; tubes moderate, situated midway between the varices or nearer the preceding varix, extending outward and backward; canal short, broad and flattened, with a small perforation; spiral sculpture of a few low ridges extending from the vicinity of the aperture to the summit of the varix, where they appear as serrations or abortive spines, but are obsolete behind the varix, or they may be absent altogether; aperture subovate, simple, with a plain elevated rim. Max. lon. of figured specimen 14.5; diam. 9.5; of a larger but less perfect one, 22 x 12 mm.

The older specimens have a proportionally longer canal and less expanded varices, which makes them appear more slender than the young; a good deal of difference in the appearance of the specimen results from the presence or absence of the elevated plate between the spine and the preceding whorl across the shoulder. This feature seems to be entirely inconstant, though I found it difficult to believe this until I found it inconstant at different stages of the same specimen.

This species, as might be expected, is nearest to the Miocene *T. acuticosta* Conrad, which has thicker and rounder varices, with a small, stubby, triangular spine at the shoulder, and an intervarical rib extending forward from the base of each tube, where *T. floridanus* is flattened. The nucleus is not preserved in any of my specimens of *floridanus*. Among recent species, *T. tetrapterus* Bronn is nearly related to *T. floridanus*, though perfectly distinct.

SUBFAMILY PURPURINÆ.

Genus **RAPANA** Schumacher.

Many heterogeneous forms, including *Ecphora*, have been referred to this genus because they happened to have a flaring umbilicus. That feature is the mechanical result of certain factors in the form of the shell which do not, necessarily, have anything to do with its systematic relations. I have already referred to *Stenomphalus* of Sandberger, which has been supposed to be congeneric with *Ecphora*. As far as one can judge from the figures alone, it is merely a *Rapana*, to which genus (typified by *R. bezoar* Linné) it should be referred.

Rapana tampaensis n. s.

Ballast Point silex-beds, Tampa Bay, Florida.

Shell rather small, short-spired; last whorl much the largest; spiral sculpture of eight or nine primary ridges, elevated and square-sided, of which one is near the suture, two others (a little larger) with subequal interspaces in front of the first, then an interspace of greater width with the strongest spiral in front of it, then the peripheral interspace, twice as wide as the strongest spiral, then another strong spiral followed by a narrower channel, and three more basal spirals with diminishing interspaces on the base, and three or four rather obscure and less elevated spiral cords on the canal; of secondary spirals much smaller than the primaries, there are one or two in the wide peripheral channel, and sometimes a single one elsewhere; lastly, the whole surface is more or less sculptured by fine, incised spiral lines. The transverse sculpture is of fine wrinkles, in harmony with the incremental lines, which cover most of the shell; the ribs are slightly but irregularly undulated in some places; aperture ovate, pillar-lip with a thin, smooth callus; edge of the outer lip undulated by the sculpture, the interior lirate, with about ten sharp, prominent liræ disposed somewhat in pairs; canal very narrow and deep, shorter than the aperture; umbilicus flaring, variable in diameter, deep, bounded by the rounded edge of the fasciole, within axially striated, but not otherwise sculptured. Lon. of shell — ?, of last whorl from the suture at the aperture forward 20.0; diam. of last whorl 21.5; of the umbilicus in two specimens 5.0 and 6.5 mm. respectively.

Having only two imperfect last whorls of this species at present, I defer figuring it in the hope of receiving better material.

Genus **CYMIA** Mörch.

Cuma Swainson, Malac., pp. 73, 87, 307, 1840; Cooke, Journ. of Conch. v. p. 172, 1887.

Not of Milne Edwards, 1828, *Crustacea.*

Cymia Mörch, Mal. Blätt. vii. p. 98, 1861.

Tritonopsis Conrad, Am. Journ. Conch. i. p. 20, 1865 (name only).

Fasciolina Conrad, Am. Journ. Conch. iii. p. 186, 1867.

Shell purpuroid, with a single strong, elevated ridge on the middle of the pillar. Type *C. tectum* Wood, W. America. The group ranges from the Upper Eocene to the recent fauna.

Mörch has pointed out that *Cuma* Humphrey (beside being a mere catalogue name not entitled to stand in any event) was a heterogeneous assembly in no way related to the present group. The name, properly proposed, is in universal use for a well-known group of *Crustacea.* Swainson's use of it for a mollusk is positively barred from both sides. Mörch's proposed substitute is therefore entitled to adoption. The *Cuma* of Tryon's Manual, as has been effectively shown by Cooke, is an heterogeneous assembly, and his remarks on the name of the group are out of harmony with the general usage of scientific men, as well as defective in knowledge of the history of the name. Conrad's undescribed *Tritonopis* (*subalveatum*), from the base of the Vicksburg beds, is a *Cymia,* as I have determined by an examination of his type.

Cymia Woodii Dall.

Fasciolaria Woodii Gabb, Journ. Acad. Nat. Sci. Phila. 2d series, iv. p. 375, pl. 67, fig. 7, 1860; Conrad, Proc. Acad. Nat. Sci. xiv. p. 561, 1863; Meek, Smithsonian Checklist Inv. Foss. Miocene, p. 21, 1864.

Fasciolina Woodii Conrad, Am. Journ. Conch. iii. p. 186, 1867.

Cuma tectum Gabb, Trans. Am. Phil. Soc., n. s., vol. xv. p. 214, 1873 (not of Wood or Kiener).

Compare *Tritonopsis subalveatum* Conrad, Journ. Acad. Nat. Sci., 2d ser., ii. p. 41, pl. 1, figs. 2, 8, 1850 = *Triton subalveatum* Conr., *op. cit.* i. p. 207, 1849.

Miocene of New Jersey, in the Shiloh marls; Texas (Meek) and of Santo Domingo (Gabb).

On examining the unique type of Gabb's *Fasciolaria Woodii*, I saw at once that it is a typical *Cymia;* but my astonishment was great when, on looking over the large series of the Miocene fossil from Santo Domingo which Gabb had referred to *Cuma tectum*, I found that the two could not be separated specifically and that neither should be referred to *C. tectum*. The *C. Woodii* is a very variable shell, with or without tubercles and peripheral carina, and varying much as some Purpuras do. The fine series at Philadelphia shows this well, and among the smoother varieties the exact duplicate of the New Jersey fossil can easily be found.

The genuine *Cymia* exists in a recent state only over a limited area on the western coast of Central America, where the typical species is found. The discovery of the genus in a fossil state on the eastern side of the continent is therefore very interesting. The small distribution of *C. tectum* would harmonize with the hypothesis that the group had barely reached the Pacific, from a Miocene Antillean center of development, when the communication between the two seas was cut off—an event accompanied by geological changes in the Antilles which exterminated the parent stock.

Cymia is to *Purpura* what *Monoptygma* is to *Oliva* or *Olivella*.

There have been two fossil species described from America under the name of *Cuma*—*C. alternata* Nelson (Tr. Conn. Acad. ii. p. 198, pl. 7, figs. 3, 4, 1870), and *C. biplicata* Gabb (Geol. Surv. Cala., Pal. ii. pp. 9, 75, pl. ii. fig. 14, 1869), from Peru and California. Neither belongs to the genus *Cymia* as properly restricted; both are probably Purpuras. *Cymia* is not known on the coast of Chile, either as a fossil or in the living state.

SUBFAMILY CORALLIOPHILINÆ.

Genus CORALLIOPHILA Adams.

Coralliophila magna n. s.

Plate 11, figures 11, 12.

Ballast Point silex-beds, Dall and Burns.

Adult shell large, stout, with eight or nine whorls, a short spire, rasp-like surface and flaring umbilicus; nucleus small, smooth; subsequent whorls transversely sculptured, with seven or eight more or less prominent, rounded ribs, which continue clear across the whorl, and with low, very thin, sharp, imbricated lamellæ corresponding to the incremental lines covering the whole shell, but most elevated and strong in front of the suture; spiral sculpture of numerous rounded threads, with about equal interspaces, which on the last whorl of the adult are sharper on the summits of the ribs and more distant, but in the young evenly overrun the ribs and surface without becoming nodulous or enlarged; aperture in the young ovate, rounded behind, with a few rather obscure teeth inside the outer lip, the inner lip with a smooth callus; the canal narrow, with a strong, imbricated fasciole and a well-defined umbilical chink; in the adult the suture is more and more appressed until there is frequently a sort of narrow channel at the posterior end of the aperture; the callus on the inner lip is heavier and the umbilical pit wider and deeper, almost like that of *Rapana*, but less deep; the canal in such cases is strongly recurved and the exterior spirals angulated at the summit. Max. length of adult specimen 60.00; diam. 30.0 mm.

Figure 11 shows a large, worn, broken specimen in which the surface-imbricating sculpture is wholly worn away, but I have other fragments which show it very sharp in still larger specimens. The umbilicus is very large and flaring in some specimens, more moderate in others; the ribs sometimes become obsolete on the last whorl; the spire may be more swollen or more acute; —in short, this, which is probably the largest species of the genus, went through just such a series of variations as do the living species. These singular modifications are likely to be lost sight of in the rage for making new specific names which has attacked a certain school of conchologists, who appear to believe that a name is an end in itself, instead of a mere handle to use in assorting and systematizing the facts of Nature.

A specific name should represent the center of inertia, in a group of individuals, from which variations radiate on all sides, or proceed like the concentric circles when a stone is dropped into still water. When names are given to every trivial mutation, it is impossible to account for and subordinate properly the mutations among themselves. Since the latter is our object, in science, those who by silly multiplication of names would block the way, may be justly stigmatized as unscientific nuisances, whose work it may soon become necessary for real students to ignore.

Coralliophila lepidota n. s.

Plate 9, figure 3.

Shell subfusiform, seven-whorled, not large, with a rasp-like surface and large, imbricating ribs; nucleus small, smooth; spiral sculpture, first, of very fine microscopic grooves over the whole surface when perfect; second, of numerous subequal or sometimes alternated rounded threads, which cover the shell and are wider, but not higher, on the summits of the ribs; transverse sculpture of thin, little-elevated, imbricating lamellæ, less prominent and regular than in *C. magna*, but of the same general character; also of eight strong, prominent, rounded ribs, which are generally sharp-edged and overhanging in front, rarely continuous at this point with the general surface, usually extending clear across the shell, most prominent at the periphery; suture very distinct, never appressed; canal short, narrow, often considerably recurved; aperture ovate, inner lip smooth and callous, outer lip sharp-edged, following the sculpture, internally with six or eight denticles at resting-stages; umbilical pit prominent, not deep, bounded by the fasciole, more or less irregular and variable; spire variable in height, usually acute at the tip. Max. lon. of adult 28.0; diam. 14.0 mm.

Pliocene marls of the Caloosahatchie and Shell Creek.

This species is especially marked by its deep and conspicuous suture. In other respects it varies like the rest of the genus, though the overhanging character of the ribs is pretty constant. This is due to the habit, when growth commences after a resting-stage, for the new growth to commence a little inside the edge of the outer lip of the resting-stage, instead of (as is usual) at the edge of that lip.

The specimen figured has the canal somewhat worn and imperfect. Better ones were afterward obtained too late for figuring.

Coralliophila abbreviata Lamarck.

Pliocene of the Caloosahatchie beds, Dall.

A few specimens agreeing fairly well with a fusiform variety of *C. abbreviata* were collected in the marl. The shell is small, subfusiform, with the whorl much appressed at the suture, giving a conical aspect to the spire, and a small umbilical chink. The canal is rather more slender and constricted off from the base than in any recent specimens I have seen, and a single thread a little more prominent than the other spirals encircles the whorls at the periphery.

SUBORDER STREPTODONTA.

Superfamily **PTENOGLOSSA.**

FAMILY SCALIDÆ.

Genus **SCALA** Humphrey.

Scala (Humphr.) Dall, Rep. Blake Gastr., p. 299, 1889.

Scala uncinaticosta Orbigny.

Scalaria uncinaticosta Orbigny, Moll. Cuba, ii. p. 19, pl. xi. figs. 25–27, 1842.

A single specimen was collected from the Caloosahatchie marls. The species is known in the living state from Barbados to St. Thomas in rather deep water.

Scala turricula Sowerby.

Scalaria turricula Sby., Thes., p. 92, figs. 61, 88.

Scala turricula Mörch, Journ. Acad. Nat. Sci. viii. p. 200, 1876.

Pliocene of the Caloosahatchie and Shell Creek, Florida. Living in the eastern Antilles, and thence northward to Cape Hatteras in 16–22 fathoms.

Scala Sayana Dall.

Scala Sayana Dall, Rep. Blake Gastr., p. 309, 1889; Bull. U. S. Nat. Mus. No. 37, p. 122, pl. 50, fig. 10, 1889

Pliocene of the Caloosahatchie; Post-Pliocene of South Carolina. Recent from Texas to Key West, and northward to Virginia.

This is the *S. clathrus* Say in part, and in Binney's Gould's " Invertebrata of Massachusetts " a figure of it is given by mistake for *S. lineata* Say. A correspondent suggests that Sowerby and Tryon were wrong in referring Kiener's *S. Humphreysi* to *S. angulata*, and that therefore this species is the genuine *S. Humphreysi*, which, being long prior to my name *Sayana*, would take precedence of it. Having recently had an opportunity of consulting Kiener's monograph, I find his figure and description by no means conclusive, and have therefore retained the name *Sayana* for the present, as it is definite and certain, while the other as yet cannot be said to be so.

Scala lineata Say.

Scala lineata (Say, 1822) Dall, Rep. Blake Gastr., p. 307, 1889.

Pliocene of the Caloosahatchie; Post-Pliocene of South Carolina and Florida. Living from Cape Cod to Charlotte Harbor, Florida, and perhaps to Texas.

Scala Frielei Dall.

Scala Frielei Dall, Rep. Blake Gastr., p. 313, 1889; Bull. U. S. Nat. Mus. No. 37, p. 124, 1889.

Post-Pliocene of North Creek, Little Sarasota Bay, West Florida. Living off the coast of North Carolina in 63–107 fathoms.

Subgenus **Opalia** H. & A. Adams.

Section *Pliciscala* De Boury.

Opalia De-Bouryi n. s.

Pliocene marls of the Caloosahatchie, one specimen.

Shell elongate, slender, nine-whorled; nucleus smooth, small; subsequent whorls rounded, contiguous, with a deep suture, sculptured everywhere with a uniform, close-set, microscopically punctate, fine spiral striation; base with a very strong, flattened spiral cord, also with an axial fasciole equally strong, the space between the two somewhat excavated and radially sculptured with slightly elevated ridges, about twice as numerous as the varices, and which do not extend beyond the outer margin of the disk; varices eight in number, continuous along the spire and lagging a little, so that each, when followed up the spire, describes about half a turn around the axis; the varices are prominent and rounded, equally strong anteriorly, ceasing at the edge of the disk and behind, especially on the upper whorls, somewhat coronated at the suture; sometimes there are incremental irregularities, and one or two of the varices on the last two whorls are a little larger than the others; aperture ovate, rounded externally, its axial margin straighter; the peristome is not double, a feature always due to the stage of growth, and which should not be used systematically. Max. lon. of shell 24.5; max. lat. 8.5; max. diam. of aperture 4.0; of the peristome 6.3; of the basal disk 5.5 mm.

This fine species will be figured in Part II. of this paper. It is one of the largest American species of the group, and the first to be noted from the tertiaries of the Atlantic coast. It is named in honor of M. E. de Boury, of France, whose excellent contributions toward the monography of this family are well known. The single specimen found is somewhat rubbed, but enough uninjured surface remains to indicate the character of the secondary sculpture.

Superfamily GYMNOGLOSSA.

FAMILY EULIMIDÆ.

Genus EULIMA Risso.

Section *Eulima* s. s.

Eulima conoidea Kurtz & Stimpson.

Plate 5, figure 11.

Eulima conoidea K. & S., Proc. Boston Soc. N. H. iv. p. 115, 1851; Kurtz, Cat. Carolinian Marine Shells, p. 8, 1860.

Pliocene of the Caloosahatchie and Shell Creek, Florida, and of South Carolina. Living from North Carolina to the Florida Keys.

This fine species has not hitherto been adequately figured. The recent form was described in 1878 as *Odostomia alba* Calkins, as I have been able to determine by a careful examination of Mr. Calkins's type-specimen.

Eulima subcarinata Orbigny.

Several immature specimens from the Caloosahatchie marls appear to be referable to this species. The recent form, which is *E. oleacea* Tryon (Man. viii. pl. 69, fig. 36), not of Kurtz and Stimpson, extends from the Antilles to North Carolina at moderate depths.

Eulima gracilis C. B. Adams.

Pliocene of the Caloosahatchie. Living from the Antilles and Yucatan northward to North Carolina.

Eulima intermedia Cantraine.

E. intermedia (Cantr.) Dall, Rep. Blake Gastr., p. 327, 1889.
E. oleacea Kurtz & Stimpson, from types, not of Tryon.

Pliocene of the Myakka River, Florida, and of Britain (Crag *fide* Jeffreys). Living on both sides of the Atlantic; abroad from Britain to the Mediterranean; in America from New England to Barbados.

Section *Melanella* Bowdich.

Eulima arcuata C. B. Adams.

Pliocene of the Caloosahatchie. Also in the Italian Pliocene. Found living on both sides of the Atlantic, and is the *E. curva* of Jeffreys and Monterosato, but not the *E. arcuata* of Sowerby in Reeve's Iconica, 1866, which is a much larger species.

Subgenus **Leiostraca** H. & A. Adams.

Eulima (Leiostraca) acuta Sowerby.

E. acuta (Sby.) Dall, Rep. Blake Gastr., p. 328, 1889.
E. bifasciata Orbigny.

Pliocene of the Caloosahatchie. Living from the West Indies northward to North Carolina, and perhaps to New England; also on the west coast of Central America.

Eulima (Leiostraca) rectiuscula Dall.

L. stenostoma Dall, Bull. U. S. Nat. Mus. No. 37, p. 126, 1889, Europ. ref. excl., not of Jeffreys.

Pliocene of the Caloosahatchie beds. Living off Fernandina, Florida, in 294 fathoms.

This species resembles *L. stenostoma* (see G. O. Sars, Moll. Reg. Arct. Norv., pl. 11, fig. 21), but is destitute of the constriction at the suture so characteristic of *stenostoma*, having the sides of the spire straight and forming an uninterrupted cone; the shell is somewhat thicker and less translucent, the coil of the whorls less oblique, the adults having one more whorl in the same length of shell, while the anterior margin is less effuse than in *E. stenostoma*. I have not seen an unmistakable *stenostoma* from the coast of America.

Genus **NISO** Risso.

Niso Willcoxiana Dall.

Plate 5, figures 5, 5 b.

Niso Willcoxiana Dall, Rep. Blake Gastr., p. 331, 1889.

Pliocene of the Caloosahatchie beds.

A very perfect specimen of this shell, obtained by Mr. Willcox since the above publication, shows markings as in *N. splendidula* Sowerby, which lives on both the American coasts, and on the Atlantic side extends from North Carolina to the Gulf of Mexico. The chief difference between the two forms, which are doubtless genetically connected, is that the living form is smaller and less expanded at the base than the fossil one. The latter has no specific resemblance whatever to the Claiborne species *N. umbilicata* Lea, which is very much smaller and with more whorls in proportion to its length, when adult.

FAMILY PYRAMIDELLIDÆ.

[The consideration of the minute and difficult species belonging to this family is temporarily deferred.]

Superfamily TÆNIOGLOSSA.

FAMILY TRITONIIDÆ.

Genus **TRITONIUM** Link.

Subgenus **Lampusia** Schumacher.

Tritonium pileare Lamarck.

An imperfect specimen from the Caloosahatchie marls, after a good deal of study, was determined to belong to this well-known species, which in the living state is widely distributed over the tropics, and on the Atlantic coast of North America extends from the Florida Keys to the coast of Mexico.

Tritonium sp. indet.

A nucleus of some species of *Tritonium*, other than *T. pileare*, with about one whorl of the succeeding series attached to it, was obtained from the marls of the Caloosahatchie, but it is impossible to determine the species.

Subgenus **Colubraria** Schumacher.

Tritonium lanceolatum Menke.

Colubraria lanceolata (Mke.) Dall, Rep. Blake Gastr., p. 225, 1889.
Ranella lanceolata Menke, Synop., p. 87, 1828. (Synon. excl.)

In the Pliocene marl of Shell Creek and the Caloosahatchie River, Florida. Living from Cape Hatteras to the Antilles.

Several specimens were obtained which do not seem to differ in any way from the recent form.

FAMILY CASSIDIDÆ.

Genus **CASSIS** Lamarck.

Subgenus **Phalium** Link.

Section *Semicassis* Mörch.

Phalium globosum n. s.

Upper Eocene of Mississippi, near Newton; and of Florida in the nummulitic limestone of Ocala, at Richard's quarry, collected by Mr. Willcox.

Shell short and globose, with four smooth nuclear and five or six subsequent sculptured whorls, exhibiting three or four varices when adult; young shell rather blunt or short-spired, with spiral sculpture of very shallow, rather wide, wavy grooves or channels, with much wider interspaces anteriorly, and behind the shoulder finer and sharper sculpture of the same sort; whorls appressed with a cord, sometimes wavy or nodulous with very small nodules, close to the suture; shoulder with two not very strong carinæ, which are usually wavy or rippled by numerous small, narrow, transverse wavelets; the aperture and callus rise to the anterior of these carinæ; outer lip thickened slightly reflected, roundly arched, feebly denticulate; inner lip callous, reflected, spirally lirate on the body behind and the pillar in front with a non-lirate space between; siphonal notch narrow, sharp, producing a strong siphonal fasciole with a channel behind it; canal short, recurved. Max. lon. of shell 17.0; of aperture 13.0; max. lat. of shell 13.0 mm. This shell has one varix beside the actual lip and was collected two and a half miles east from Newton, Mississippi.

The adult shell, which is only known from internal casts and gutta-percha squeezes from natural molds found at Ocala, reaches a length of 55.0 and a minimum width of 45.0 mm., judging from the casts; it retains the short, globose shape and exhibits on the last half whorl eight or ten somewhat flexuous ribs, beginning at the suture and extending beyond the periphery, fairly well marked on the casts. The shell appears to have been rather thin and the liration of the aperture was doubtless more prominent and general than in the young shell above described. The spiral sculpture has left no traces on the cast of the last whorl except internally, where three or more faint ridges indicate a grooving or liration of the columella.

The incremental lines are quite evident on the young shell, which they sometimes reticulate feebly, and on the adult were still noticeable.

This shell is shorter and more globose in form than any of the described species from the American Tertiary. The young are most like the young of *Semicassis cœlatura* Conrad, which is a more elongated, narrower shell, with much coarser and rougher sculpture, and in which the adult is not ribbed. The figure of this species will appear in Part II. of this paper.

Phalium Aldrichi n. s.

Lower Miocene of the Chipola beds, Chipola River, N. W. Florida.

Shell small, stout, solid, subglobose, with three smooth nuclear and four subsequent whorls; spiral sculpture on the last whorl in front of the shoulder of fourteen primary, strong, flattish, wide, elevated ridges, with much narrower interspaces; a single fine, intercalary thread is sometimes present in most of the channels; the peripheral spiral is larger than the others, but not so large as that at the shoulder; on the shoulder are three primary, more or less rippled spirals, the first at the suture, which is not appressed; in the channel in front of it is a single secondary thread, the second channel has two, and between the third primary and the shoulder are three fine threads close together, forming a sort of band behind the tuberculous shoulder; the tubercles here are squarish and about fifteen on the last whorl; transverse sculpture of rather regularly spaced, impressed lines, which cut the primary spirals in a way to recall by the result the ends of shingles on a roof, as the irregularities are not nodules, and have their long slope toward the aperture; the shell now described has two past varices; outer lip much thickened, with a deep groove behind it; inside it has about eighteen strong liræ, unpaired and with wider interspaces; inner lip heavily callous, reflected, strongly pustular, lirate at the base of the pillar and on the body; canal narrow, short, strongly recurved; axis pervious; siphonal notch very deeply cut; siphonal fasciole strong, with a deep channel behind it; the callus of the aperture reaches to the shoulder. Max. lon. of shell 26.0; of aperture 21.0; max. lat. 19.0 mm.

The specimen described came from Ten-Mile Creek, Chipola River, collected by Mr. Burns. Its nearest relative seems to be *C. cœlatura*, which is quite differently sculptured and proportioned. It is named in honor of Mr T. H. Aldrich, who is doing so much to increase our knowledge of the Southern Eocene fauna of the United States. A figure will appear later.

FAMILY DOLIIDÆ.

Genus **PYRULA** Lamarck.

Pyrula papyratia Say.

Pyrula papyratia Say, Journ. Acad. Nat. Sci. Phila., 1st series, ii. p. 238, 1822; Tryon, Man. vii. p. 266, pl. 6, fig. 35, 1885; Dall, Bull. U. S. Nat. Mus. No. 37, p. 134, 1889.

Fossil in the Pliocene marls of the Caloosahatchie and the Post-Pliocene of the Carolinas and of Florida. Living from North Carolina to the West Indies.

The specimens are not common in the marl, perhaps on account of their fragility, but they are perfectly identical with the living specimens in every detail. The species is the *P. gracilis* of Philippi, and was referred to as *P. reticulata* by Prof. Heilprin in his list of Caloosahatchie fossils, these Transactions, volume i. p. 103.

FAMILY OVULIDÆ.

Genus **OVULA** Bruguière.

The writer had taken it for granted that the Messrs. Adams and Mörch were justified in quoting Meuschen as an authority on nomenclature. Lately, having sought for many years to obtain a copy of Meuschen's work, but in vain, he was enabled to examine a copy. His astonishment may be imagined at the discovery that Meuschen did not, apparently, have the remotest idea of a binomial nomenclature, and is no more entitled to be quoted in that line than Aristotle or Fabius Colonna. On the other hand, his catalogue seems destitute of any scientific value, and is not to be named in the same day with Klein, Adanson and others, who were men of genius, although they did not adopt the Linnean nomenclature. As a result Meuschen's names must be absolutely discarded, including the name *Amphiperas* and the family *Amphiperasidæ* based upon it, which have so long enjoyed a currency to which they were in no respect entitled.

Subgenus **Transovula** Gregorio.

Ovula (Transovula) multicarinata n. s.

Plate 10, figures 10, 11.

Upper Eocene of Martin's Station, Marion County, and Richard's quarry, Ocala, Florida, with *Nummulites Willcoxii* and *N. floridana*.

Shell subglobular, slightly more slender in front, involute, solid, thin, deeply, regularly, spirally channelled, with square-cut, elevated, narrower interspaces or ridges covering the whole surface of the adult, but feeble in the young; outer lip broad and thick, the ridges and channels continued over it from the outside to the inner margin, but not farther; aperture moderately wide, of even width, channelled at the posterior commissure and axially twisted; incremental lines feeble; occasionally in the middle of the spiral channels a single extremely fine, weak intercalary thread appears. Max. lon. of internal cast 36; max. lat. 24 mm.

The specimen figured from Martin's Station shows the exterior, although imperfect. It is a siliceous, hollow pseudomorph, and the outer lip has been broken, revealing the interior, covered with fine crystals. The specimens from Ocala, of which one is figured, are internal casts.

The only form which is likely to be confounded with this is *Cyprædia fenestralis* Conrad, which is found also at Ocala as well as Vicksburg, Miss. But the latter is a regular *Cypræa*, except that it is fenestrated, which the present species is not, there being no longitudinal elevated lines. The young, judging by the interior of casts, has an almost smooth surface, the spirals leaving but a trace on the mold, inside of the penultimate whorl.

The only other forms belonging to this group which have been mentioned in our paleontological literature are *Ovula iota* Conrad (which is a *Volvula*), and *O.* (*Cyphoma*) *gibbosum*, which is found fossil in the Costa Rica Pliocene.

The subgenus *Transovula*, according to Fischer, was erected to receive species of *Ovula* with both sides of the aperture dentate. I have not seen the original description or type. Dr. Fischer says: "Shell oval, feebly rostrate; lip denticulate; columellar border crenulate; type *O. Schefferi* Greg." Eocene of Italy. These characters in one sense are true of our shell, yet it may be that the present species would belong elsewhere. Until further information is available I prefer to use Gregorio's name.

FAMILY CYPRÆIDÆ.

Genus **CYPRÆA** Linné.

Cypræa pinguis Conrad.

Plate 11, figures 1, 1 a.

Cypræa pinguis Conrad, in Wailes's Geol. Miss., p. 289, pl. xvii. figs. 3 a, 3 b, 1854 (Jackson Group); Conrad, Proc. Acad. Nat. Sci. Phila. vii. p. 262, 1855.

Cypræa tumulus Heilprin, Trans. Wagner Inst. i. p. 111, pl. 16, figs. 49, 49 a, 1887 (Tampa silex-beds).

Eocene of Creole Bluff, Grant Parish, Louisiana (L. C. Johnson). Lower

Miocene at Ballast Point, Tampa Bay, in the silex-beds; White Beach, Little Sarasota Bay, Florida, and North Carolina Miocene, probably, but as internal casts of which one cannot be certain.

A comparison of types results in the above consolidation. The transverse lines on the base of Prof. Heilprin's specimen are exceptional and appear to be due to the process of mineralization or of weathering before the pseudomorph was formed. Five specimens in excellent condition do not show it. This species is related to *C. sphæroides* Conrad, which is more inflated and globose and larger, beside showing differences in the teeth. It also recalls *C. obesa* and *C. media* Deshayes, of the Parisian Eocene, though smaller than either; and like them is stratigraphically associated with a sulcate form named by Conrad *Sulcocypræa.* Of this section Deshayes figures two or three Parisian species; one, *S. lintea* Conrad, is known from our later Eocene.

A single species, *C. Smithii* Aldrich, has been described from the earlier Eocene of Alabama (Gregg's Landing beds). *C. sphæroides* Conrad is from the Claibornian, and is the type of his worthless genus *Cypræorbis*, a synonym of the section *Luponia* Gray. In the Upper Eocene, beside *C. Heilprini* and *pinguis*, which pass into the Miocene, there is a cancellated form, *C.* (*Cyprædia*) *fenestralis* Conrad, which occurs at Vicksburg and in the Ocala limestones.

C. annulifera Conrad is a *C. annulus*, dropped by some Indian or trader on the Yorktown Peninsula. It retains some of its color, is not a fossil, and only one specimen has ever been found. There is no good reason why it should be retained in our lists.

In Tuomey's Report on the Geology of South Carolina, 1848, among the Eocene fossils enumerated are *Cypræa lapidosa* Conrad, *C. semen* and *C. hemisphærica* Tuomey. These are mere names, never having been described or figured. The type of the *C. lapidosa* is still to be found in the museum of the Academy of Natural Sciences. It is an unrecognizable internal cast which may even not be a *Cypræa.*

In the Miocene, beside *C. pinguis* and *C. Heilprini*, we have in the lower beds a fine species which I have named *C. Willcoxii*, and in the upper beds, beside *Trivia pediculus* L., we have the splendid *C. carolinensis* Conrad, which, when well preserved, shows that its color-pattern was of small, round, dark spots on a lighter ground. The reference of *C. carolinensis* by Tuomey and Holmes to the Pliocene is part of the confusion between the Miocene and Pliocene which pervades that otherwise praiseworthy work.

In the Pliocene we have the extraordinary *Siphocypræa* and several species of *Trivia.*

In the West Indian Miocene there are a good many forms of *Cypræa* which require more careful study. I cannot altogether accept some of Gabb's determinations. *C. Henekeni* Sowerby is a precursor of *C. mus*, and the species referred by Guppy to *C. pustulata*, and by Gabb to *C. nucleus*, was finally described by Guppy as *C. Gabbiana.*

Cypræa sphæroides has a more sigmoid aperture and deeper apical pit than *C. pinguis*.

Cypræa pinguis varies a little in relative height and considerably in size, beside the variations due to age, in the appearance of the teeth, and the width of the aperture. My largest Ballast Point specimen measures 34.0 mm. long, and the smallest one only 19.0 mm.! But such discrepancies are well known among recent species.

Cypræa Heilprinii n. s.

Plate 11, figures 2, 2 a.

This species is best described by comparison with *C. pinguis*. It differs from the latter in being more cylindrical; in its somewhat straighter and proportionally narrower aperture, which is also less curved at the posterior commissure; in being less elevated in proportion to its length, and having the posterior slope of its dome less abrupt; in being more attenuated laterally at either end, and in the greater production of the extreme ends of the base; lastly, it appears to average smaller than *pinguis*, and none of the specimens indicate any such *Aricia*-like basal callus as *pinguis* assumes in its fullest stage of development. The specimens show nothing of the spire; the teeth are strong but small, and not extended (even faintly) across the basal callus: there are twenty-two on the right lip and about eighteen on the left, which latter are less prominent. The largest specimen measures 26.5 mm. long, 17.0 mm. wide and 15.0 mm. high. The smallest was only 21.5 mm. long, but of about the same proportions.

This is a very pretty little species, and elegantly shaped. It seems sufficiently distinct from *C. pinguis*. It was collected at Ballast Point by Messrs. Newman, Shepard and Crosby, where it was associated with the other fossils of the silex-beds, and also in the orbitolite bed immediately above the silex-beds, under and about the town of Tampa; and it was found in the Eocene (Vicksburg) limestone of Ocala, Florida, where it is represented only by molds, by Mr. Willcox.

Cypræa Willcoxi n. s.

Plate 5, figures 12 b, 12 c.

Shell large, solid, with a narrow, closely denticulate aperture, and slightly flattened, moderately wide base; the shell has much the form of *C. cinerea*, from which it differs chiefly in its much larger size, more deeply cut and upturned posterior commissure, and less swollen base. There are about twenty-two teeth on the right lip, which appears to rise vertically inside the shell to a rather unusual height, the whole of which is crossed by the teeth, which, however, do not extend laterally on the base. Max. lon. of shell 46.0; lat. of shell 32.0; alt. of shell 25.0 mm.

Lower Miocene. In the Chipola red sand, West Florida (Burns); and at White Beach, near Osprey, Florida, at the northern part of Little Sarasota

Bay, in a water-worn sandstone of yellowish brown color, by Messrs. Willcox and Dall.

This species is the largest fossil form from the United States except *C. carolinensis*, which is a much thinner and lighter shell, with a wider and less uniform aperture, recalling that of *C. mus* L. With it were found small internal casts recalling *C. pinguis*, but the fossils in this particular ledge are so poorly preserved for the most part as to be hardly identified with absolute confidence. *C. Willcoxii* reaches a length of 64.0, and a width of 42.0 mm. The specimen figured has suffered a little at the lower end of the aperture, figure 12 c, in the process of cutting out the matrix.

Subgenus **Siphocypræa** Heilprin.

Siphocypræa Heilprin, Trans. Wagner Inst. i. p. 86, 1887.

This remarkable form of *Cypræa* differs from all other species recent and fossil in the prolongation of the posterior commissure of the aperture by a comma-shaped sulcus coiled over the apical region. This would indicate either a central filament at the junction of the expanded halves of the mantle, thus preventing the usual deposition of callus at that point, or a double spiral prolongation at this part of the margin of the mantle. It is unlikely that the position of the respiratory siphon differed from that of other Cypræas, as the form of the young shell does not lend itself to this hypothesis. It is more probable that we have to do in this case with a unique and special case of modification and development at the posterior sinus.

Cypræa (Siphocypræa) problematica Heilprin.

Plate 5, figures 10, 10 b.

Siphocypræa problematica Heilprin, *op. cit.* pp. 87, 133, pl. iv. figs. 12, 12 a, 12 b, pl. xvi. a, fig. 73.

The young shell which I have figured, as above mentioned, instead of exhibiting a pointed spire like most Cypræas, after the first three whorls shows an apical, cup-shaped depression, exhibiting the volutions, in the centre of which the nuclear tip appears a little elevated. The last whorl rises more and more until the animal commences to form its thickened lip. The posterior extremity of the right lip is first thickened, and the callus curves to the left and upward. At the same time a callous deposit is made on the body opposite and parallel to the first-mentioned. The deposition continues on both sides, the right side for some time getting the larger share, but after a time the deposit ceases or becomes less rapid on the right and more so on the left. The left-hand wall of callus finally overshadows the curved projection on the right, and the latter is frequently somewhat resorbed at the tip, while the wall representing the outline of the head of the " comma " becomes very prominent and almost tubular. The adult shell varies in form from slightly pyriform to subcylindrical; the basal callus is but little flattened or expanded laterally; the teeth are rather variable in strength and number, apart from differences due to age. The base in life seems to have been white, the dome yellow brown with darker dots of color. Notwithstanding the beautiful preservation of some of the specimens, I have been unable to find any trace of the line which on recent Cypræas marks the junction of the two mantle-lobes on the dome of the shell.

Of recent species, *Cypræa edentula*, from the Cape of Good Hope, recalls the younger stages of this shell. The only approach to the fossil among recent Antillean forms, so far as known, is shown by *Cypræa mus* L., where there is a short, shallow channel in some specimens extending upward from the posterior commissure, while the young shell has a rather blunt spire. But in all the recent Antillean species the aperture in the adult terminates to the right of the apex of the spire, and so far as I know, in the whole family, *C. problematica* is the only species in which the terminal commissure is bent to the left of the apex, to say nothing of coiling around it.

Genus **TRIVIA** Gray.

Trivia suffusa Gray.

Trivia pediculus Tuomey & Holmes (non Lin.), Pleioc. Fos. S. C., p. 127, pl. 27, fig. 3 a, b, 1857.

Caloosahatchie beds. Pliocene of South Carolina. Miocene of North Carolina? [Emmons]. Recent, Florida from Cedar Keys southward, and in the Antilles.

Trivia pediculus Linné.

Miocene of the Carolinas? Pliocene of Costa Rica and the Caloosahatchie beds. Recent in the Antilles and South Florida.

Trivia globosa Gray.

Caloosahatchie beds. Recent in the Gulf of Mexico and among the Antilles.

Genus **ERATO** Risso.

Erato Maugeriæ Gray.

Erato Maugeriæ Gray, S. V. Wood, Crag. Moll. 1, p. 19, pl. ii. figs. 11 a, 11 b.
Erato lævis Emmons (non Donovan), N. Car. Geol. Rep., p. 262, fig. 139, 1858.

Miocene marls of Cape Fear River, North Carolina, Emmons. Pliocene of Shell Creek and the Caloosahatchie beds, Florida. Red and Coralline Crag of Sutton, England, Wood. Recent, from the North Carolina coast at Cape Hatteras to the West Indies.

This little shell is rather common in the Caloosahatchie marl.

Mr. Tryon in his monograph speaks of seeing plaits on the pillar of young specimens of *Erato*. My observations do not confirm this. The adult *Erato* has the anterior margin of the pillar a little thickened, with a short groove behind it and a few faint denticles on the body opposite the outer lip. The callus on the pillar-edge is irregularly laid on and sometimes shows faint grooves, but I have never seen anything like a true plait on the pillar of an *Erato*, old or young. There are frequently a few denticles on the body near the posterior end of the aperture, but the line is almost always interrupted toward the middle of the pillar-lip.

FAMILY STROMBIDÆ.

Genus **ROSTELLARIA** Lamarck.

Subgenus **Orthaulax** Gabb.

Orthaulax Gabb, Proc. Acad. Nat. Sci. xxiv. p. 272, 1872. Type *O. inornatus* Gabb, *op. cit.* pl. 9, figs. 3, 4. Miocene of Santo Domingo.

Orthaulax Gabb, Geol. St. Dom., p. 274, 1873. Guppy, Quart. Journ. Geol. Soc., Nov., 1876, p. 520, pl. xxviii. fig. 8; Tryon, Man. ii. p. 192, 1883.

Hippochrenes (pars) Zittel, Tr. de Paléont. ii. p. 258, 1887.

Wagneria Heilprin, Trans. Wagner Inst. i. p. 105, 1887. Type *W. pugnax* Heilprin, *op. cit.* p. 106, pl. 15, figs. 36, 36 a. Miocene of Florida.

This group was described by Gabb from immature specimens, and no perfect specimen has hitherto been figured, for which reason a good deal of doubt has rested upon it.

At first, when I examined young specimens of a genuine *Orthaulax*, I was struck by their resemblance to *Leiorhynus* Gabb, and at once suspected that the latter was only a young specimen of the former. But on examining the type-species of *Leiorhynus* I found that this was not the case, since that shell bore evidences of maturity, has a thickened and lirate lip, is not self-enveloped by the last whorl, and has numerous varices. It is, in short, a form which permanently retains some of the external features of immature *Orthaulax* while adding to them others which are not found in *Orthaulax*.

The genus *Wagneria* of Heilprin is founded on characters which are simply part of the process of mineralization. The type of *Wagneria* is a siliceous pseudomorph ; the very thick coating of the spire having been only partially replaced by silica, thus leaving a hollow, geodic dome analogous to nothing in the original shell.

A similar state of affairs is found in many of the fossils of that locality, which present a thickness too great to permit of solid silicification. All the corals, some of the Turritellas, etc., offer examples of this kind. For the rest, the relation of his shell to *Orthaulax* was not overlooked by Prof. Heilprin, though he was misled by the state of his material. The name *Wagneria* in any event was preoccupied, and if the genus had proved valid another name would have had to be substituted.

Orthaulax is almost intermediate between *Rostellaria* and *Strombus*. It differs from *Hippochrenes* Montfort, to which it was referred by Guppy and Zittel, in the following characters:

It has not the long, anteriorly produced pillar, nor the widely expanded outer lip ; *Hippochrenes* has the last whorl, when adult, posteriorly extended to the tip of the spire, marking the conclusion of its growth; *Orthaulax* while very young has the whorls gradually ascending upon the normal juvenile spire by such an expansion, which, when developed, is continuous, enveloping the whole spire, coiling round and round it as the whorls grow, and completely concealing the whole of the spire, nothing but the outside of the last whorl being visible in an adult specimen.

Orthaulax pugnax Heilprin.

Plate 8, figures 5, 8.

Wagneria pugnax Heilprin, Trans. Wagner Inst. i. p. 105, pl. 15, figs. 36, 36 a, 1887.

Tampa silex-beds at Ballast Point (Lower Miocene).

No perfect specimen of this species has yet been found. The restoration of the outer lip and anterior end in the figures was made by following the indications of the incremental lines on the siliceous pseudomorph. They are probably not far from the truth, but this awaits confirmation. The thin outer lip is almost always broken; out of more than a hundred specimens of the Chipola *Orthaulax* only two, and those not adult, showed the form of the outer lip. It has not the anterior sinus found in *Strombus* near the canal. The anterior end was probably recurved somewhat. In a perfect specimen the whole spire would be covered by the posterior prolongation of the outer whorl, and the channel from the posterior commissure of the aperture would run to or nearly to the apex of the spire. None of the fragments I have seen are sufficiently near the Santo Domingo species to render it likely that they are the same. *O. inornata* appears to be much more slender and elongate, and with a more elevated and conical spire. There is always a heavy callus on the body in front of the post-apertural channel. In the very young the spire is shorter than in *O. Gabbi*, reversing the conditions of the adult.

Orthaulax Gabbi n. s.

Plate 12, figures 5, 5 a, 5 b.

Lower Miocene bed of Alum Bluff, and Chipola beds, W. Florida.

Shell large, solid, many-whorled; in the very young (Fig. 5) smooth and polished, except for incremental lines and a few faintly impressed spiral lines anteriorly; nucleus small, polished, glassy, not differentiated from the rest of the shell; early whorls with a very distinct, not channelled suture; the whorl in front of it slightly turrited; each whorl after the third has three slightly elevated, narrow, rounded varices, somewhat irregularly spaced, so that they do not follow each other continuously down the slope of the spire; about the end of the eighth whorl the posterior edge of the outside whorl begins to be prolonged backward more and more as the shell grows, so that the suture thus formed makes an irregular spiral line ascending the spire over the antecedent whorls until by about the tenth turn the whole of the spire is enveloped, as well as any barnacles, vermetus, or other semiparasitic growth which may have become attached to the surface of the spire; the anterior part of the shell has the shape of *Leiorhynus*, the pillar is rather thick and slightly recurved, with a moderately distinct fasciole; the canal moderately wide, shorter than the pillar; the outer lip simple, sharp, a little thickened at the resting-stages, but not lirate internally; body with a moderate callus, which at the resting-stages is considerably enlarged, so that when the whorl comes to grow over it (as it is not absorbed) it produces an irregularity somewhat like a varix; the whorls are ovately rounded, smooth, except for occasional transverse undulations due to irregularities of growth, and polished; no indications of color-pattern have been observed.

The adolescent form (Figs. 5 a, 5 b) a good deal resembles a *Strombus*, except that the anterior sulcus of the outer lip behind the canal is absent or represented only by the faintest wave in the margin; the spire is entirely enveloped by the backward prolongation of the last whorl, except at the tip, where the envelope is usually a little eroded or defective; there appears to be a resting-stage at every two-thirds of a revolution of the whorl around the axis, for which reason, looking down on the spire, the outline of the shell transverse to the axis is subtriangular or three-sided; the outer lip is simple, rather sharp-edged, and very slightly, if at all, recurved; it extends backward to the tip of the spire, near which it recedes somewhat from its parallelism with the axis; at the shoulder, also, it is slightly excavated and thickened; the body is smooth, with a moderate callus, which becomes thicker near the shoulder; at the shoulder, in front of the excavation above noted, it becomes very thick, and is continued on to the spire parallel with the outer lip, and very near it, so that between the two is a narrow, flexuous groove of considerable depth; when the shell begins to grow again the whorl is carried over this ridge, which is not absorbed, and the surface is thus rendered, as it were, varicose; the canal is short, strongly recurved, with a remarkably deep siphonal sulcus, so that the end of the pillar stands forward in a marked way; on the shoulder, half way around the shell, is an ill-defined, narrow ridge, which ceases a little way behind the lip. The dimensions of the figured specimen are: Lon. 68.0; max. lat. 35.0 mm.

The adult form differs from the adolescent by the disproportionate strength of the ridge at the shoulder, by which the surface behind the ridge has become flattish as in a *Cassis*, but more irregular, and the width at the shoulder has increased in proportion to the total length. No entirely complete specimen of the adult has been found, but from the numerous fragments the proportions can be approximately determined. The max. diam. is 74.0, and the length about 110.0 mm., of which 15.0 mm. are behind the shoulder, while, in the specimen only 68.0 mm. long, there are 17.0 mm. of length behind the shoulder.

This species appears abundantly, though in a poor state of preservation, in the lower bed at Alum Bluff, and in the Chipola beds to the westward. The group in America would seem to be characteristic of the lower beds of the Southern Miocene, as far as our present knowledge permits us to judge.

I have observed that, occasionally, the ridge on the shoulder in young specimens is represented by a nodule rather than a ridge.

The essential difference between *Orthaulax* and *Hippochrenes*, *Calyptrophorus*, *Rimella*, etc., is that the involution of the spire, once commenced, is carried on by the posterior edge of the last or growing whorl continuously from the young condition in *Orthaulax;* while in the others the spire remains normal until the shell reaches its adult state and then, with the changes in the mantle, which incite the deposition of the thickened and enlarged outer lip, a process is developed at the posterior commissure of the aperture and mantle, which deposits enamel on the spire against which it lies, and it thus forms a gutter, sometimes straight, sometimes recurved, in which it is sheltered; apart from this the spire is enveloped, if at all, not by any expansion of the lip, but by a deposit of enamel which covers the whole, as frosting does a cake, without any relation to the coil of the shell considered as an organic product. Strip off the whole involving, continuous enamel from *Calyptrophorus* and the whorls will remain intact; strip off the equivalent deposit in *Orthaulax* and the shell itself is destroyed. The latter, so far as its structure is concerned, is more nearly like an involute *Terebellum* (such as *T. sopitum* Brander, figured by Zittel) than like the enamelled *Calyptrophorus* or winged *Hippochrenes*.

The latter wait until they have attained their majority and then spread their outer lips and lay down their enamel, once for all. In *Orthaulax* the involution, as in *Ovulum*, begins before maturity and continues with the growth of the shell without regard to its age or periodical resting-stages. In this particular it is clearly distinguished from any other group included in the *Strombidæ*, excepting the sufficiently distinct *Terebellum*.

Subgenus **Rimella** Agassiz.

Rimella Smithii n. s.

Plate 10, figures 4, 6.

Upper Eocene at Martin Station, Marion County, Florida, and at Richard's quarry, Ocala, Florida.

Shell small, slender, subfusiform, with an acute spire and nine or ten gently rounded, reticulated whorls; each whorl has one prominent, thick, rounded varix, over which the sculpture passes unchanged, but the adult shell terminates in an elaborate sharp-edged lip and gutter as in ordinary *Rimella;* spiral sculpture of numerous regular, rounded, even threads, with subequal interspaces covering the whole shell; transverse sculpture, first, of the aforesaid varices, which are not regularly spaced, but are found one on each whorl to the very apex, representing resting-stages; secondly, of numerous (on the penultimate whorl about 30) rather sharp, elevated ridges, with wider interspaces extending clear across the whorls and overridden, without nodulation, by the spirals; lastly, by very fine, close, even, little-elevated ridges with equal interspaces, covering the whole surface, but only visible where it is well preserved; suture well marked; pillar stout, a little recurved; canal short; aperture narrow, pointed at each end; outer lip prominent, varicose, constricted in the middle, inside thickened and contracted; body with a thick, elevated callus; these two masses of callus approach and nearly meet behind, being barely separated at the posterior commissure, behind which the gutter widens somewhat with elevated sides, and is continued nearly to the apex of the spire and recurved on the other side for a short distance. Max. lon. of shell 24.0; max. lat. 10.0 mm.

The specimen from Martin Station was a siliceous pseudomorph, the Ocala specimen was a mold, both imperfect, but affording the above characters by combination. There is no other American species resembling it at all nearly, so that comparisons are unnecessary.

Genus **STROMBUS** Linné.

This genus, derived from Linneus, who gave it a name of very ancient date, but which had not previously been restricted to a natural group, was revised by Lamarck, whose sole example (Prodrome, 1799) was *S. pugilis* L., which must be regarded as the type. The characters of the group in the Lamarckian sense intergrade, so that it is difficult to divide the genus into sections. The typical species has an unguiculate operculum strengthened by a midrib, and having its thin outer edge sharply serrate with angular retrorse prickles. Nearly related species (*S. inermis* Swainson, *S. bituberculatus* Lamarck) have both edges of the operculum entire and smooth, so that the character used by Gabb to separate the *Strombidæ* into subfamilies is not of more than specific rank. The liration of the outer lip, which is present in *S. pugilis* of Eastern America, is absent in its west-coast analogue *S. gracilior*. A remarkable character which I have not seen alluded to by anybody is the development in many Strombs of elevated and complex plaits at the posterior commissure of the aperture, though there are none on the anterior part of the pillar. In accordance with the hypothesis broached in the earlier portion of this paper, I regard this development as closely related to the posterior expansion and attendant filament of the mantle in this genus, especially as it is more marked in species which have a wide posterior expansion (*S. gallus* L., *S. bituberculatus* Lam., *S. costatus* Gmelin) than in closely related forms in which the expansion is less (*S. pugilis*, *S. inermis* Swainson, *S. integer* Swainson), whether these forms be regarded as distinct species or not. Furthermore, these ridges are more numerous and more emphatic (though not always as elevated) in the young shell with a narrow aperture, where the mantle when withdrawn is much compressed, than they are in the same shell when adult, when the aperture is expanded and the retracted mantle has more room.

These plaits are best shown by sections of the adult shell exposing the interior of the whorls.

To understand the relations of our fossil species it is necessary to have a clear idea of the recent forms. The Pacific species are closely related to the Atlantic species, and doubtless of the same ancestry. *S. gracilior* and *S. pugilis*, *S. granulatus* and *bituberculatus*, *S. peruvianus* and *costatus* march in pairs.

In the Atlantic and Antillean region we have the typical, pinkish, rather small, sharply tuberculate, unicolored *S. pugilis.* To the north, and especially in the Floridian region, this becomes larger, maculated with dark brown in bands, zigzags, or even entirely brown; the tubercles are less marked relatively to the size of the shell, and in the variety *alatus* disappear altogether. At present, in the southern and western Antilles, and on the north coast of South America, there are no *S. pugilis* with zigzag brown markings. But in the Miocene of Haiti and Jamaica the fossil *S. proximus* Sby. (*pugiloides* Guppy + *ambiguus* Sowerby) shows the zigzags very plainly.

A good many fossils have been referred to *S. pugilis* which should be placed elsewhere.

Beside the well-known *S. gigas* L., living in the West Indies and South Florida, and fossil in the Miocene of Santo Domingo (Gabb), we have in the present fauna *S. gallus* L., *S. bituberculatus* Lamarck, and a group of forms, including the short, heavy *C. costatus* Gmelin (*accipitrinus* Lamarck), with a few large tubercles on the back; the light, slender, more elongate and not very large *inermis* of Swainson, with a few small, regular tubercles on the shoulder, and the outer surface marbled with brown; and lastly, the large, solid, white *S. integer* of Swainson found on the Bahamas Banks and some of the Floridian Keys. A dwarfish specimen of this has been named *S. haitensis* by Sowerby, from the Haiti Miocene, and erroneously referred to *S. bituberculatus* by Gabb. The variation among the members of this group is obviously great, and they may perhaps all be regarded as varieties of one species; but without attempting to settle that question here, for convenience, I shall refer to the varieties, if such they are, as if they were species. Add to this list *S. Leidyi* Hp., and we have enumerated all the species of true *Strombus* which have been referred to in connection with the paleontology of North America, beside several which are not known in a fossil state. For this list, I am now able to give an amended schedule as follows: Upper Eocene, one species; Lower Miocene, two species; Pliocene, two species.

Strombus albirupianus n. s.

Plate 12, figures 2, 10.

Upper Eocene (Jackson) white limestone overlying the Claiborne sands at Claiborne Bluff, Alabama.

Shell of six or more whorls; nuclear part lost; whole surface spirally sculptured with feeble, elevated ridges, with wider interspaces; the ridges or threads coarser in front of the suture and near the canal; transverse sculpture on the early whorls of obscure ribs, chiefly apparent as stout tubercles, which on the later whorls are more or less vertically flattened and may number ten to fourteen or more on the last whorl; whorls turrited by the shoulder, which on the last whorl is subcarinate, with the tubercles on the carina, behind which the shell is somewhat excavated, the surface rising and somewhat appressed at the suture, which is very distinct; aperture narrow, not extended behind the carina of the body-whorl, toward which the expanded lip rises a little from the line of the shoulder, which last angulates the aperture; outer lip hardly reflected, somewhat thickened internally; inner lip lightly coated with callus, lirate behind, with small but distinct liræ; pillar a little twisted, with a faint siphonal fasciole; genital sulcus of the outer lip distinct, small and rather deep, quite anteriorly placed. Max. lon. of shell somewhat exceeding 55.0; max. lat. 26.0 mm.

This interesting form is remarkable for its narrow form, which gives to the molds by which we know it somewhat the appearance of those of *Conus*. The molds give a deceptive look of height to the spire; when gutta-percha casts are taken, it is seen to be of about the usual height in *S. pugilis* and other allied species. It is intimately related, as will be seen, to the Lower Miocene species which succeed it, through which its kinship to the recent species may apparently be traced.

The type-specimens in the National Museum were received from the American Museum of Natural History at New York, through Prof. R. P. Whitfield, and specimens of the species are undoubtedly contained in the New York collection.

Strombus Aldrichi n. s.

Plate 12, figures 1, 4.

Lower Miocene of the Chipola beds, at Ten-Mile Creek, one mile west of Bailey's Ferry; and on the Chipola River, one mile below Bailey's Ferry, West Florida, Burns.

Shell of moderate size, with about nine whorls, of which two are small, smooth and nuclear; subsequent whorls spirally threaded and ribbed or tuberculate at the shoulder; spirals fine, variable, most threadlike on the early whorls, on the last whorl wavy and obsolete; early whorls transversely ribbed with 10–14 small, rounded riblets, which gradually become fewer and more nodulous until nothing but the nodules are left; on the first half of the last whorl the nodules are obsolete, on the second half there are three or four large nodules much larger than any others on the shell; behind the shoulder the shell is slightly excavated and the suture distinctly appressed and sometimes marginated by a few extra large spirals in front of it; in the vicinity of the last nodule the posterior edge of the last whorl is produced backward until it reaches the second or third whorl, counting backward; on the back of the last whorl are often a few feeble, elevated, irregular waves or obscure tubercles midway between the shoulder and the canal, recalling the stronger and more numerous waves in *S. granulatus;* aperture narrow, produced backward, squarish behind, with a groove at the commissure and an obscure subsutural ridge; outer lip in front of the angle nearly straight, smooth inside, or with a few faint granulations or lirations anteriorly; genital sulcus well marked; canal short, recurved; body with a wide and moderately thick coat of callus, but no liræ. Max. lon. of shell 62.0: max. lat. 36.0 mm.

This fine species forms, in its characters, a sort of transition from *S. albirupianus* toward *S. pugilis* and *S. granulatus* of the recent fauna, being more like the latter than the former. It is also recalled by the *S. Bonellii* Brogn. of the European Miocene (Dax, Vienna Basin), which is a larger and less elegant species. *S. Aldrichi* cannot be regarded as a link in the ancestral chain of *S. pugilis*, since the latter was already in existence in the Haitian Miocene, but its relations to *S. granulatus* are closer. At all events, it combines characters which in recent species seem to be parted among several specific forms.

This species is very abundant in the Chipola beds, holding there much such a place as *S. pugilis* does at some points on the Floridian coast to-day. It varies very much as *pugilis* does, having varieties corresponding to var. *alatus* and other mutations of *pugilis*. The strength and to some extent the character of the spirals on the last whorl varies: sometimes we have two sets of coarser and finer wavy grooves, with wider, flattish interspaces; sometimes the fine grooves are obsolete and the sculpture is of wide, well-marked, rounded channels, with rounded, not much elevated ridges between them. The sculpture of the young, as might be expected, is more uniform, and the species is sufficiently characteristic to be easily recognized, even in its most extreme variations.

Strombus chipolana n. s.

Plate 4, figure 1.

? ? *Strombus bifrons* Sowerby, Quart. Journ. Geol. Soc. vi. p. 49, pl. 9, fig. 9, 1850.

Chipola beds, with *S. Aldrichi*, but less common. Ballast Point silex-beds, Tampa, Florida.

Shell with nine or ten whorls, of which about two are small, smooth and nuclear, the others ribbed, varicose, tuberculate and spirally sculptured; early whorls with twelve or more narrow, rounded ribs, gradually becoming angular, tuberculate, larger, and finally tubercles pure and simple, of which there are nine or ten on the shoulder of the last whorl, the last or penultimate being the most prominent of all; spiral sculpture of rounded threads, becoming gradually obsolete, and on the last whorl narrower and more distant than in *S. Aldrichi* in most cases, but varying much as in that species; spire variable in height, sometimes high and slender as in the silex-fossil figured, but generally much the same proportions as in *S. Aldrichi*; last whorl attenuated anteriorly; shoulder less excavated and less regular than in *Aldrichi*, usually with two more prominent threads in front of the somewhat appressed suture; outer lip widest behind, little ascending, not reaching the suture at the beginning of the last whorl; commissure deep, narrow, not grooved; there is no subsutural ridge, but on the body behind are four or five liræ; outer lip angulated and widest at the shoulder, simple, a row of small, short liræ within it as in dwarf specimens of *S. bituberculatus;* pillar with a thin callus, sharply recurved in front with a distinct fasciole; canal narrow, much recurved, obliquely truncate; genital sulcus distinct; last whorl sometimes wavy on the back as in *S. integer.* Max. lon. of adult shell 70.0; max. lat. 45.0 mm.

This form recalls the smallest specimens of *S. bituberculatus* and is the analogue of *S. coronatus* Defrance, of the European Miocene, but is considerably smaller. It is much less common than *S. Aldrichi,* from which it may readily be distinguished by its non-ascending posterior lip, its lirate body and throat and the general form of the aperture. It transmits several of the features of *S. albirupianus,* and we fancy that they seem to reappear in the recent *S. bituberculatus* Lam. It may possibly be identical with Sowerby's *S. bifrons,* but which is a much smaller shell, of which the aperture has not been figured. The differences appear too great to unite them without more data.

Strombus pugilis Linné.

Strombus pugilis Linné, Syst. Nat. xii. p. 1209; Gmelin, S. N., p. 3512; Dillwyn, Cat. Rec. Sh. ii. p. 664, 1817.

Strombus alatus Gmelin, *op. cit.* p. 3513.

Strombus Sloanii Leach, Zool. Miscel. i. pl. 22, 1814.

Strombus ambiguus Sowerby, Quart. Journ. Geol. Soc. vi. p. 49, 1850.

Strombus proximus Sowerby, *op. cit.* p. 49, pl. 9, fig. 8, 1850.

Strombus pugilis Guppy, *op. cit.* xxii. p. 287.

Strombus fragilis Moore, *op. cit.* xix. p. 511.

Strombus pugiloides Guppy, Geol. Mag., decade ii. vol. 1, p. 442, 1874.

Strombus proximus Guppy, Quart. Journ. Geol. Soc. Nov., 1876, p. 521.

Strombus pugilis, var. *alatus,* Heilp., Trans. Wagner Inst. i. p. 86, 1887.

Miocene of Haiti, Jamaica, Anguilla, and Costa Rica (var. *proximus* [Sby.] Guppy). Pliocene of Costa Rica and of South Florida at Myakka River, Shell Creek, Alligator Creek, and on the Caloosahatchie River (typical form and var. *alatus*). Post-Pliocene of Red Bluff, North Creek and West Florida, generally of South and North Carolina as far as Cape Hatteras.

If we examine a full geographical series of this species, we shall notice at once that the southern specimens are smaller, with sharper and more prominent spines, and of a uniform rufous-pink color. The northern specimens are much larger, variegated externally with rich dark brown, and with relatively shorter spines. The presence or absence of spines is a feature probably related directly to the environment as previously described in the case of *Melongena corona.* The variety without them seems more common in Florida than in the Antilles, and forms the variety *alatus* of Gmelin. But a spineless variety is also found in the South. In the Pliocene of Florida the var. *alatus* is more common by far than the spiny form, but both are found there. In the Antillean Miocene the variety *proximus* Sby. preserves sometimes the dark zigzag lines of color which at the present time are peculiar to northern specimens.

The fossils have the size of the living *pugilis* of the same waters, and are partly spiny and partly smooth. The *S. gracilior* is a member of this stock, ancestors of which evidently migrated from the Antillean region before the communication between the two oceans was closed. It preserves the small size and rufous tint of the Antillean type, and though it reaches quite as far north on the Pacific as the latitude of Florida, shows no disposition to take on the brown ornamentation of the Floridian forms of *pugilis*. Another link between the *S. proximus* and the recent *S. gracilior* is afforded by the smooth outer lip common to both. The liration of the outer lip I have not seen at all in the Miocene shells, it is occasional but rare and exceptional with the Pliocene specimens, while the living shells when fully adult always exhibit traces and generally strong liræ. The Pliocene *alatus* are as large as the recent ones, and so are the spiny specimens. In the Caloosahatchie beds the specimens appear at all levels, but, like other shallow-water species, are more abundant near the top, which was deposited in very shallow water.

Strombus Leidyi Heilprin.

Strombus Leidyi Heilp., Trans. Wagner Inst. i. pp. 85, 103, pls. 6, 7, 1887.

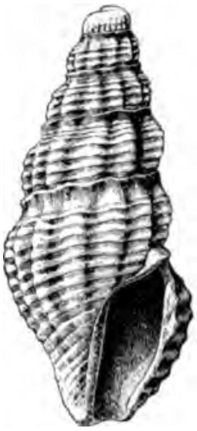
Conorbis sp. (*princeps*) Heilp. MS., Proc. Acad. Nat. Sci. Phil. 1886, pp. 12, 227, *olim*. Am. Nat. xx. p. 754, Aug. 1886; young shell. (Not described.)

Pliocene of the Caloosahatchie beds.

This species resembles *S. inermis* and *S. integer* of the recent fauna, to which it is evidently related, but the young shells are entirely distinct, and whatever be the fate of the group of forms arrayed under the head of *costatus*, *integer*, etc., there can be no doubt of the distinctness of this one. The very young shell has a small, smooth nucleus of about two whorls, followed by about twelve sculptured whorls. Normally the earlier ones are finely, spirally threaded all over, each whorl with four little-prominent varices, between which are several narrow riblets still less elevated. The whorls appear closely appressed at the suture, and flattened or even a little excavated in the adolescent shell. In the latter it may be seen that there is really a deep, narrow channel at the suture; the body-whorl is sharply, spirally sulcate, with wider, flat interspaces, and there is a broad band of sharp, subsutural lirations, fine and close together like a skein of coarse silk, wound around the body of the shell. The shell in this state is remarkably like a *Conorbis*, and if supposed to be adult would be pronounced to belong to that genus by any conchologist. The pillar is remarkably straight for a stromb, which enhances the deception. The height and acuteness of the spire vary a good deal, as in all strombs, and so does the nodulation on the back. I have examined a good many specimens of the variety *integer*, which is common on the Bahamas, and even reaches some of the Florida Keys. It is closely related to *inermis*, and neither has any subsutural liræ. The variety *costatus* or *accipitrinus*, however, shows a narrow band, but much less marked than in the fossil, while the aperture is of an entirely different shape.

PLATE II.

Fig. 1. *Drillia sedilia* Dall; 10.0; p. 33.
Fig. 2. *Drillia* (*lissotropis* var. ?) *perpolita* Dall; 9.75; p. 36.
Fig. 3. *Daphnella cingulata* Dall; 15.5; p. 38.
Fig. 4. *Daphnella modesta* Dall; 6.5; p. 39.
Fig. 5. *Cythara terminula* Dall; 16.0; p. 38.
Fig. 6. *Drillia bigemma* Dall; 8.0; p. 35.
Fig. 7. *Glyphostoma Watsoni* Dall; 7.5; p. 40.
Fig. 8. *Drillia ebenina* Dall; 16. 5; p. 33.
Fig. 9. *Drillia podagrina* Dall; 14.0; p. 34.
Fig. 10. *Drillia piscator* Dall; 9.3; p. 34.
Fig. 11. *Drillia acucincta* Dall; 20.0; p. 32.
Fig. 12. *Drillia rugata* Dall; 21.2; p. 32.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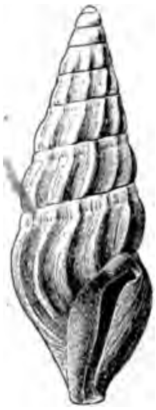
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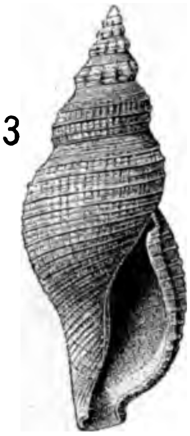
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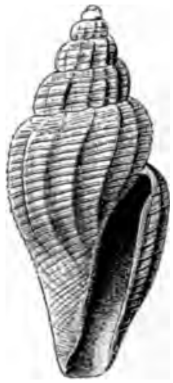
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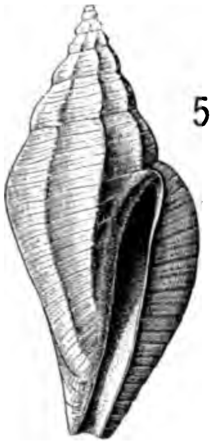
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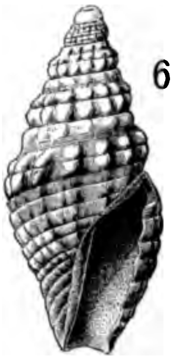
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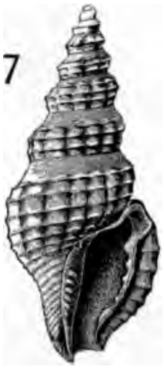
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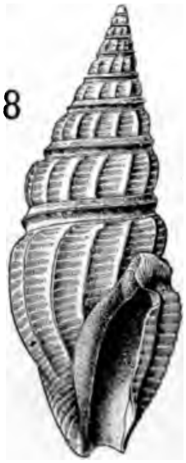
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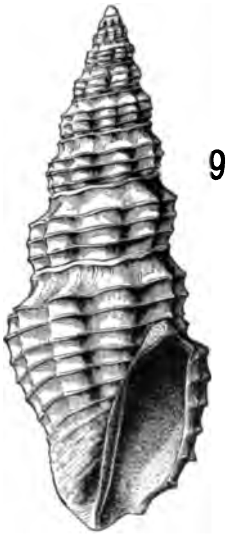
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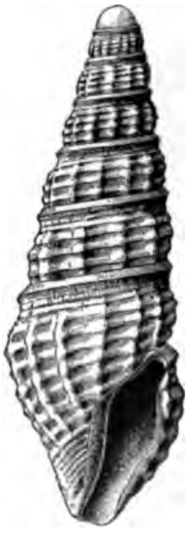
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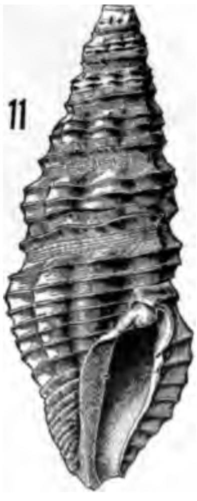
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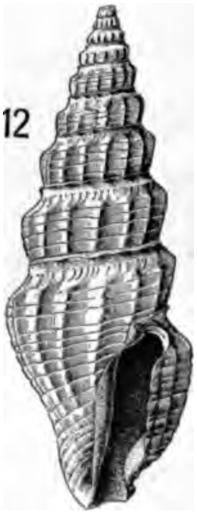
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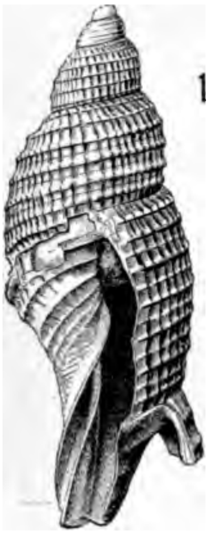
GASTROPODS OF THE FLORIDA TERTIARY



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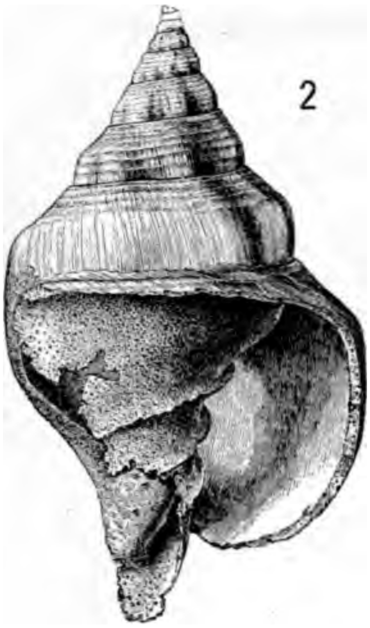

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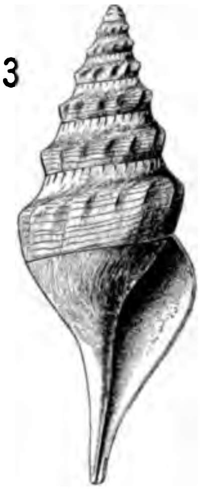

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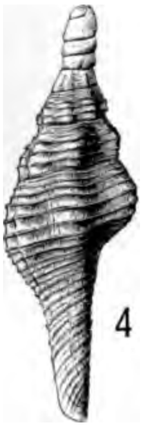

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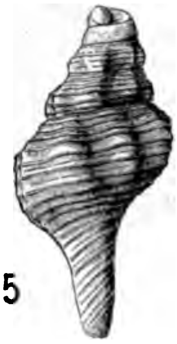

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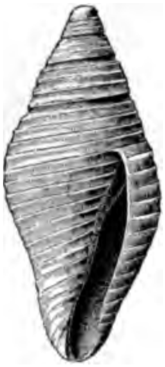

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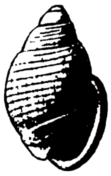

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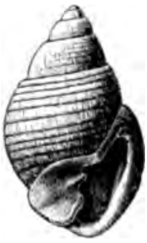

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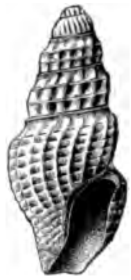

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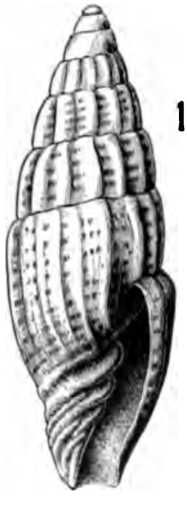

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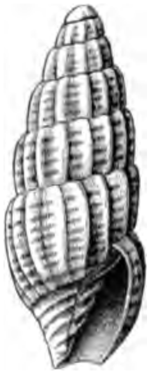

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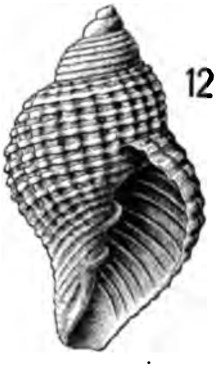

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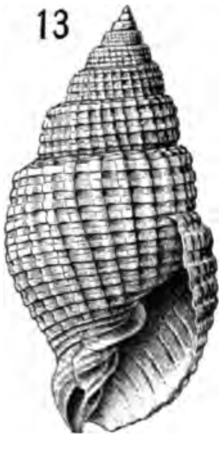


13

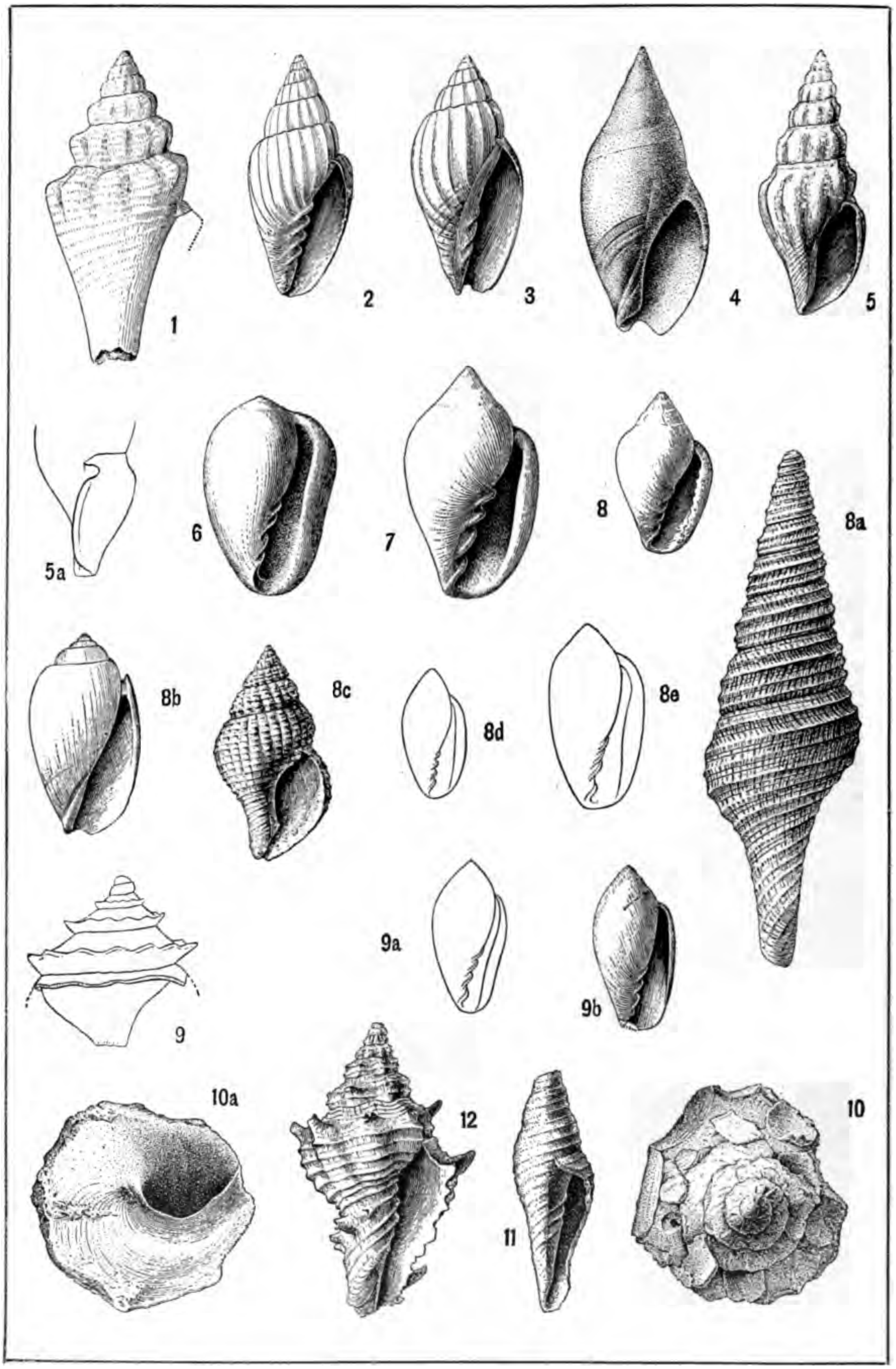
GASTROPODS OF THE FLORIDA TERTIARY

PLATE III.

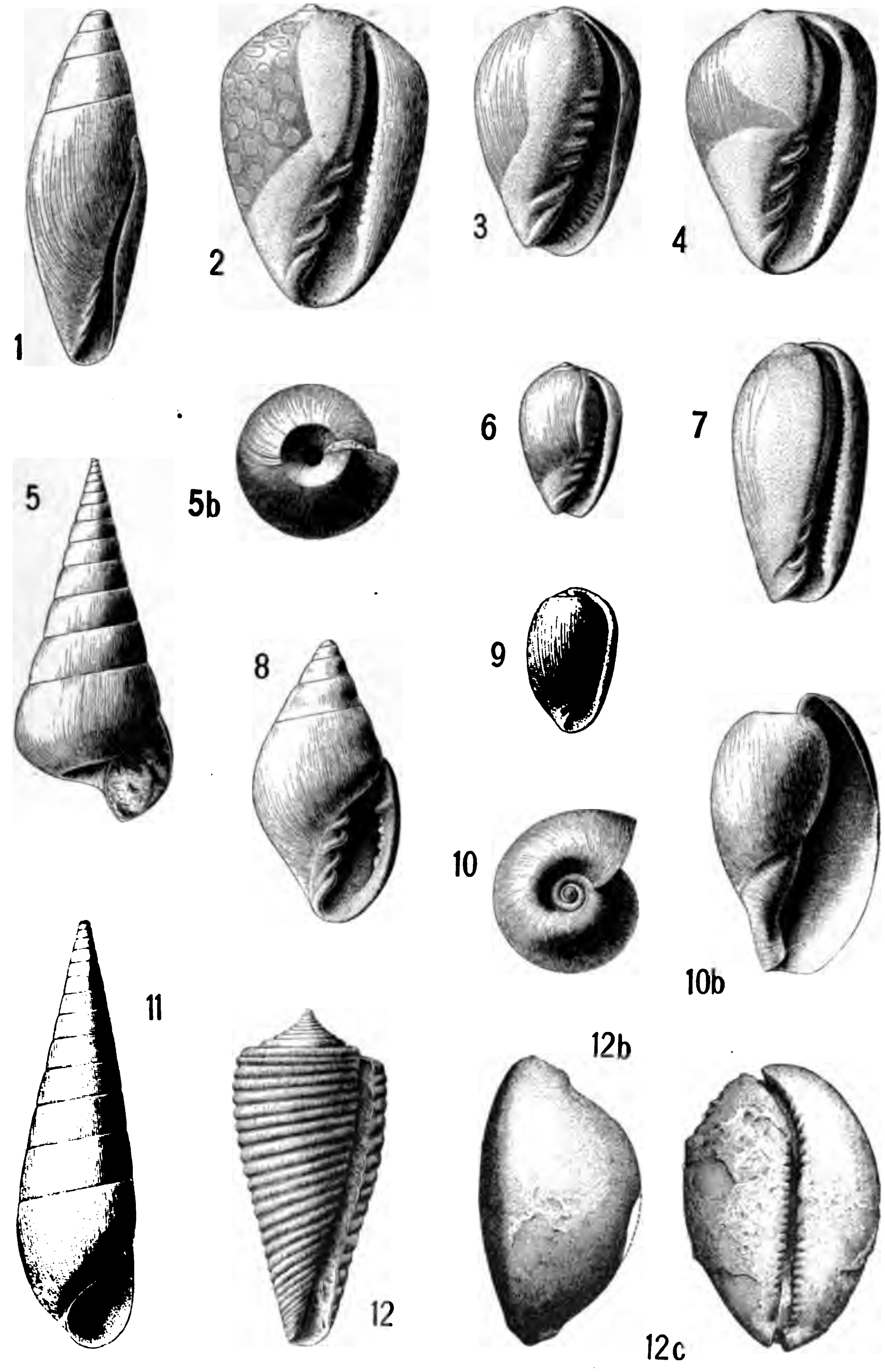
Fig. 1. *Perplicaria perplexa* Dall; 13.0; p. 90.
Fig. 2. *Turbinella scolymoides* Dall; 231.0; p. 98.
Fig. 3. *Pleurotomella chariessa* Watson, var. *pistillata* Dall; 16.0; p. 41.
Fig. 4. *Turbinella regina* Heilprin; tip with nucleus; 42.0; p. 98.
Fig. 5. *Turbinella scolymoides* Dall; decollate tip; 33.0; p. 98.
Fig. 6. *Mitromorpha cincta* Dall; 7.2; p. 95.
Fig. 7. *Ringicula* (*floridana* var.?) *Guppyi* Dall; 1.6; p. 14.
Fig. 8. *Ringicula floridana* Dall; same scale as fig. 7; 2.5; p. 14.
Fig. 9. *Drillia edilia* Dall; 4.0; p. 35.
Fig. 10. *Mitra Willcoxii* Dall; 8.3; p. 93.
Fig. 11. *Mitra Holmesii* Dall; 4.1; p. 92.
Fig. 12. *Cancellaria venusta* T. & H.; 22.0; p. 43.
Fig. 13. *Cancellaria Conradiana* Dall; 38.0; p. 42.

PLATE IV.

Fig. 1. *Strombus chipolana* Dall; fragment; 40.0; p. 176.
Fig. 2. *Conomitra staminea* Conrad; typical form; 15.0; p. 94.
Fig. 3. *Lyria pulchella* Sby., Young; 29.0; p. 85.
Fig. 4. *Ancillaria Shepardi* Dall; 34.75; p. 46.
Fig. 5. *Drillia Newmani* Dall; 12.5; p. 29.
Fig. 5 a. The same, last whorl viewed from the side, to show the form of the notch.
Fig. 6. *Marginella ballista* Dall; 18.0; p. 47.
Fig. 7. *Marginella elegantula* Dall; 11.0; p. 54.
Fig. 8. *Marginella Newmani* Dall; 5.5; p. 54.
Fig. 8 a. *Pleurotoma albida* Perry; 36.0; p. 28.
Fig. 8 b. *Olivella lata* Dall; 9.25; p. 45.
Fig. 8 c. *Tritonidea pauper* Dall; 9.5; p. 129.
Fig. 8 d. *Marginella bella* Conrad, var. *inepta* Dall; 5.5; p. 53.
Fig. 8 e. *Marginella bella*, var. *bellula* Dall; 6.5; p. 53.
Fig. 9. *Fulgur stellatum* Dall; fragment of spire with nucleus; lat. 17.0; p. 114.
Fig. 9 a. *Marginella bella* Conrad, typical form; 8.0; p. 53.
Fig. 9 b. *Marginella faunula* Dall; 8.0; p. 53.
Figs. 10, 10 a. *Xenophora humilis* Conrad, nat. size.
Fig. 11. *Mitra silicata* Dall; 29.0; p. 93.
Fig. 12. *Turbinella* (*Vasum*) *subcapitellum* Heilprin; 27.0; p. 99.



GASTROPODS OF THE FLORIDA TERTIARY.



GASTROPODS OF THE FLORIDA TERTIARY.

PLATE V.

Fig. 1. *Marginella styria* Dall ; 5.55 ; p. 54.
Fig. 2. *Marginella* (*apicina* var. ?) *pardalis* Dall ; 10.0 ; p. 49.
Fig. 3. *Marginella gravida* Dall ; 8.3 ; p. 55.
Fig. 4. *Marginella precursor* Dall ; 16.0 ; p. 47.
Fig. 5. *Niso Willcoxiana* Dall ; 31.0 ; p. 160.
Fig. 5 b. The same, view of the base ; 13.0 ; p. 160.
Fig. 6. *Marginella floridana* Dall ; 5.0 ; p. 49.
Fig. 7. *Marginella Willcoxiana* Dall ; 16.6 ; p. 50.
Fig. 8. *Marginella denticulata* Conrad ; 8.0 ; p. 51.
Fig. 9. *Volutella amiantula* Dall ; 2.5 ; p. 56.
Fig. 10. *Cypræa* (*Siphocypræa*) *problematica* Heilprin ; summit of young shell ; p. 167.
Fig. 10 b. The same ; front view of young shell ; 38.0 ; p. 167.
Fig. 11. *Eulima conoidea* Kurtz & Stimpson ; 13.0 ; p. 159.
Fig. 12. *Conus cruzianus* Dall ; 27.5 ; p. 25.
Fig. 12 b. *Cypræa Willcoxii* Dall ; 46.0 ; p. 166.
Fig. 12 c. The same, view of the base ; 46.0 ; p. 166.

PLATE VI.

Fig. 1. *Volutilithes precursor* Dall; 28.0; pp. 74, 76, 77, 84.

Fig. 2. *Lyria costata* Sowerby; American specimen; 32.0; pp. 76, 85.

Fig. 3. *Volutilithes spinosa* Lamarck; tip showing nucleus, enlarged; p. 74.

Fig. 3 a. *Volutopupa cithara* Lamarck; enlarged tip showing pupoid nucleus; p. 77.

Fig. 4. *Volutilithes Philippiana* Dall, recent species; p. 74.

Fig. 4 a. *Marginella aurora* Dall; 26.0; p. 51.

Fig. 5. Larval shell taken from the ovicapsule of the recent *Scaphella magellanica* Sby., showing calcarella; 5.0; p. 70.

Fig. 5 a. *Voluta?* sp. ind.; showing bulbous nucleus; 10.0; p. 77.

Fig. 6. *Lapparia dumosa* Conrad; enlarged tip showing caricella nucleus and early cancellated whorls; p. 79.

Fig. 7. *Voluta virescens* Lamarck; tip showing nucleus; p. 77.

Fig. 8. *Voluta musica* L.; showing sculptured nucleus; p. 77.

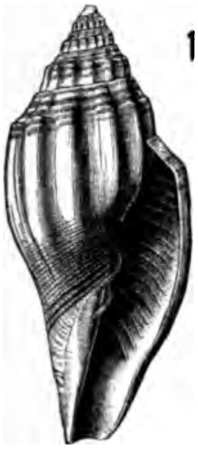
Fig. 9. *Caricella Leana* Dall; 26.0; pp. 78, 86.

Fig. 10. *Scaphella Trenholmii* T. & H., young specimen from Alum Bluff, Florida; 58.0; p. 88.

Fig. 11. *Caricella subangulata* Conrad, young shell; the adult has the middle of the outer lip much more arched; 57.0; pp. 78, 87.

Fig. 12. *Liopeplum Spillmani* Dall; 41.0; pp. 73, 82.

Fig. 12 a. *Liopeplum subjugosum* Dall; 45.0; pp. 73, 83.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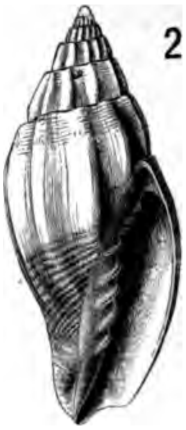
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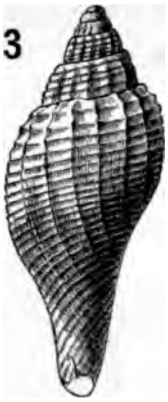
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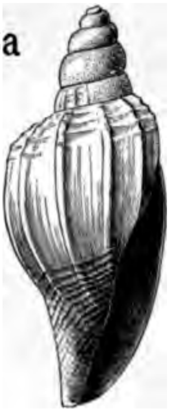
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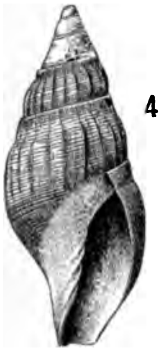
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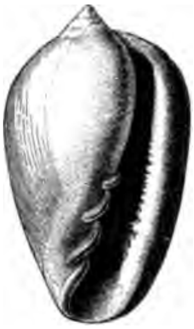
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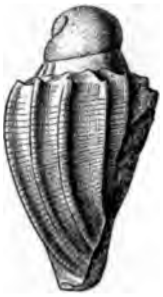
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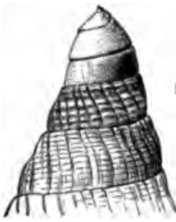
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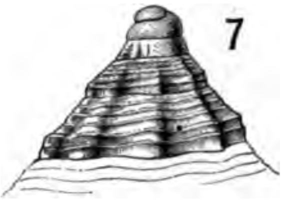
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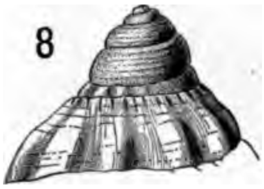
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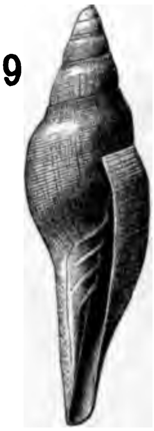
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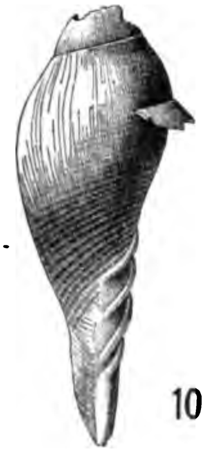
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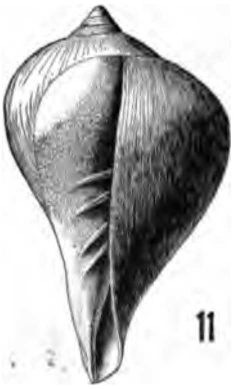
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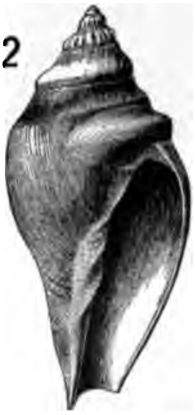
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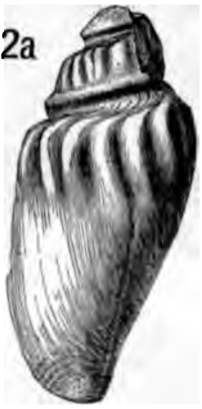
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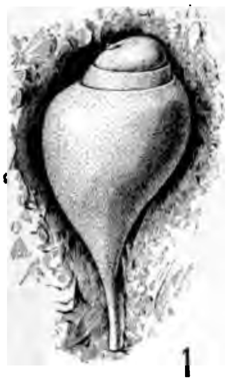
TERTIARY GASTROPODS OF FLORIDA.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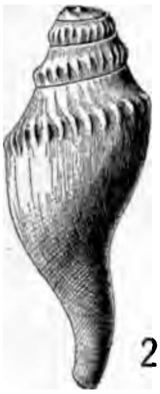
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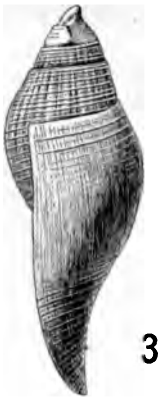
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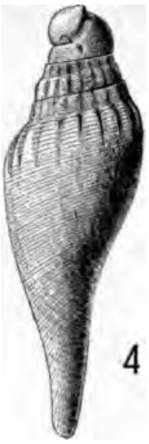
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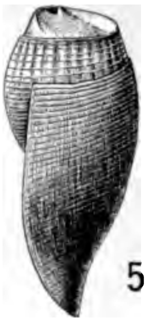
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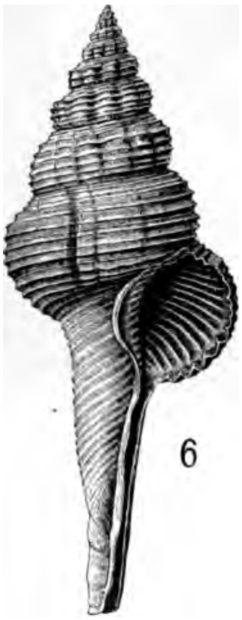
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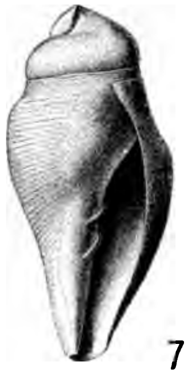
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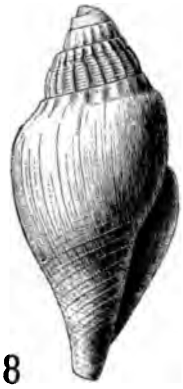
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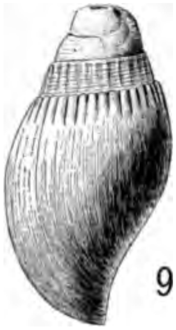
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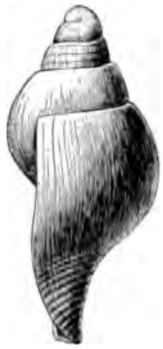
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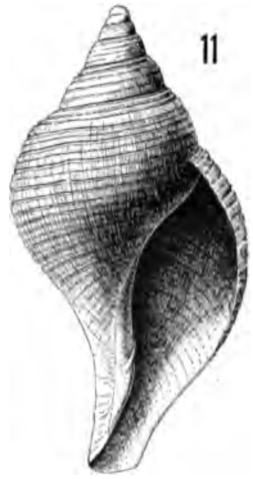
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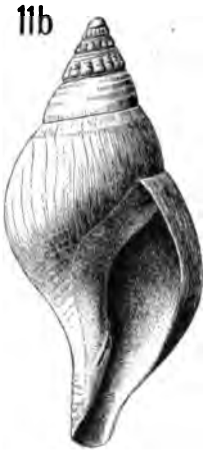
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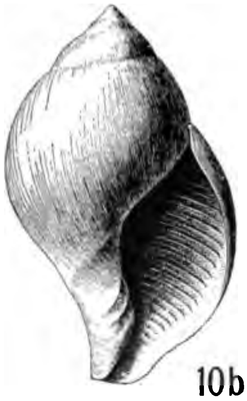
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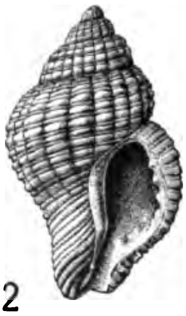
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GASTROPODS OF THE FLORIDA TERTIARY.

PLATE VII.

Fig. 1. *Eucymba ocalana* Dall; internal cast of young specimen; 48.5; pp. 70, 81.

Fig. 2. *Scaphella* (*Aurinia*) *Gouldiana* Dall; tip enlarged to show nucleus; pp. 80, 81.

Fig. 3. *Scaphella* (*Caricella*) *demissa* Conrad; tip showing the place of attachment of the protoconch; p. 78.

Fig. 4. *Scaphella* (*Aurinia*) *dubia* Brod.; tip enlarged; pp. 77, 80.

Fig. 5. *Scaphella* (*Aurinia*) *robusta* Dall; tip enlarged, showing seat of protoconch and calcarella; pp. 80, 81.

Fig. 6. *Fusus timessus* Dall, Gulf of Mexico; recent representative of *F. caloosaensis* Heilprin; 90.0; p. 127.

Fig. 7. *Scaphella obtusa* Emmons; young shell, authentic specimen enlarged; p. 80.

Fig. 8. *Scaphella floridana* Heilprin; tip enlarged; pp. 70, 89.

Fig. 9. *Scaphella junonia* Hwass; tip enlarged, showing seat of protoconch and absence of calcarella; pp. 70, 79.

Fig. 10. *Fasciolaria distans* Lam.; tip enlarged to show the nucleus; 10.0; p. 102.

Fig. 10 b. *Fasciolaria* (*Liochlamys*) *bulbosa* (Hp.) Dall; showing the true plaits and the glazed surface; 48.0; p. 101.

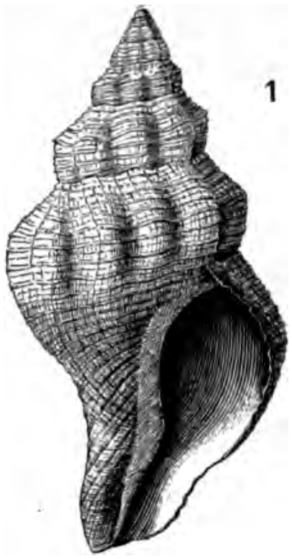
Fig. 11. *Fasciolaria tulipa* Linn.; young shell, showing nucleus and grooved early whorls; 20.0; p. 101.

Fig. 11 b. *Fasciolaria apicina* Dall; young shell, showing nucleus and ribbed early whorls; 23.0; p. 102.

Fig. 12. *Urosalpinx trossulus* Conrad, var. *curtus* Dall; 13 0; p. 148.

PLATE VIII.

Fig. 1. *Latirus* (*floridanus* var. ?) *callimorphus* Dall; 41.0; p. 107.
Fig. 2. *Latirus floridanus* Heilprin; 38.0; p. 106.
Fig. 3. *Melongena sculpturata* Dall; young, without spines; 60.0; p. 118.
Fig. 4. *Fusus nexilis* Dall; 12.0; p. 127.
Fig. 5. *Orthaulax pugnax* Heilprin; type-specimen; 68.0; p. 170.
Fig. 6. *Latirus rugatus* Dall, var.; 37.0; p. 107.
Fig. 7. *Latirus rugatus* Dall, 42.0; p. 107.
Fig. 8. *Orthaulax pugnax* Heilprin; from above; 44.0; p. 170.
Fig. 9. *Muricidea spinulosa* Heilprin; from the type-specimen, 26.0; p. 149.



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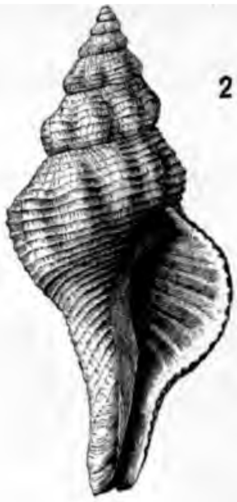

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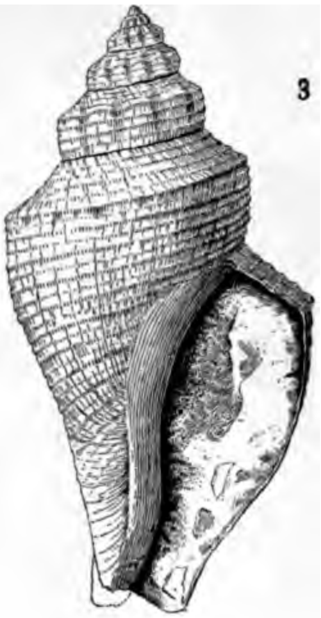

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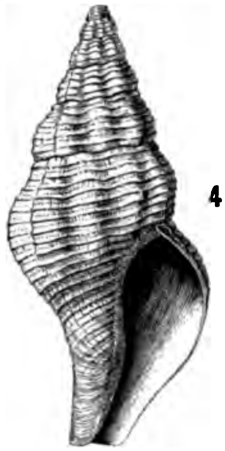

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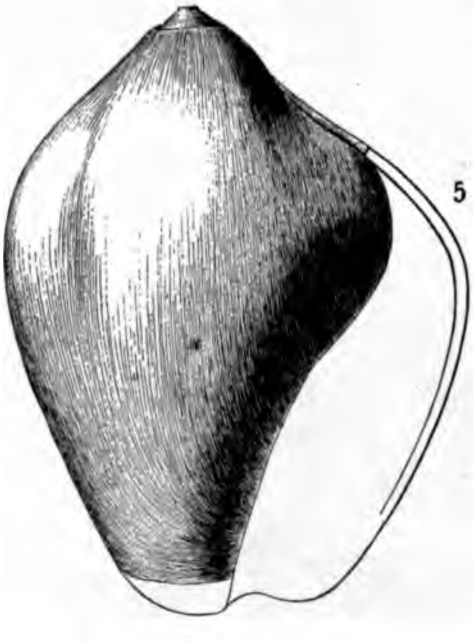

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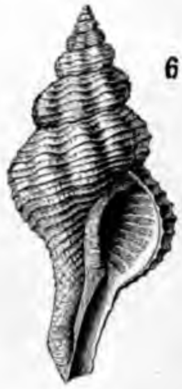

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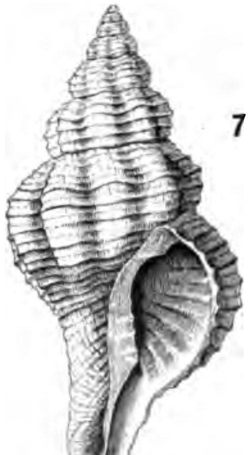

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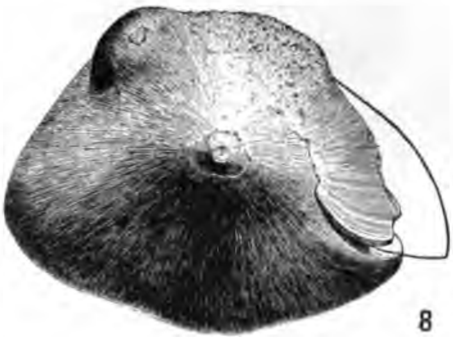

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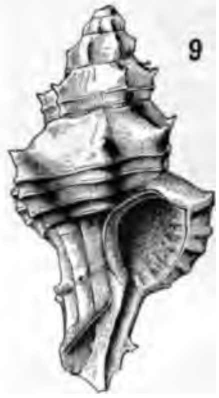

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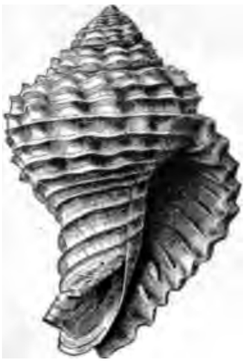
GASTROPODS OF THE FLORIDA TERTIARY.



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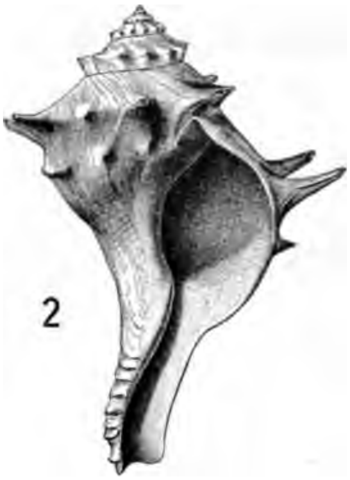

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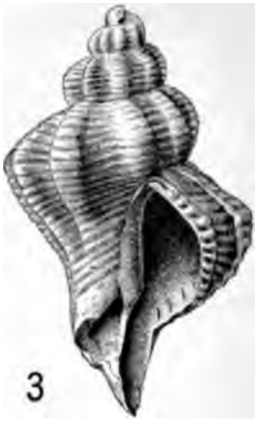

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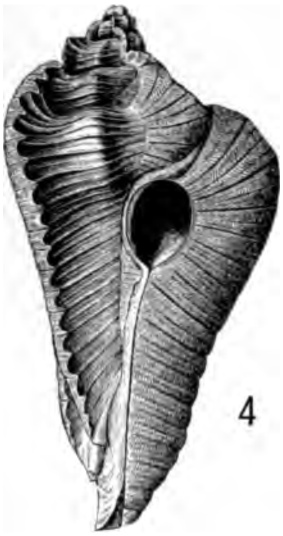

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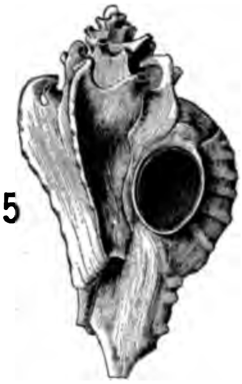

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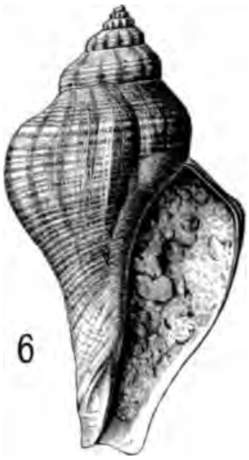

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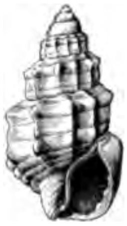

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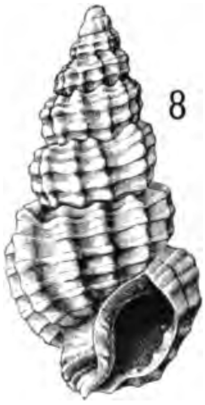

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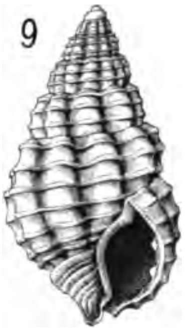

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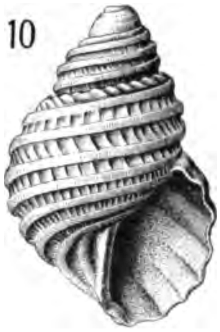

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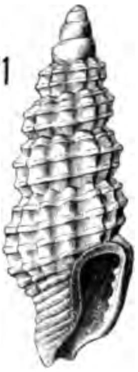

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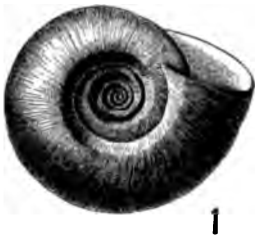
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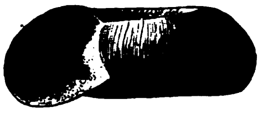
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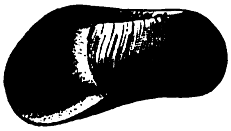
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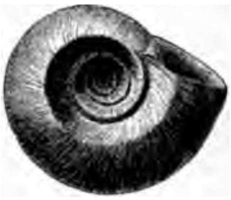
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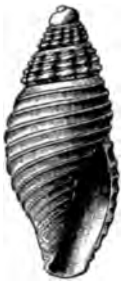
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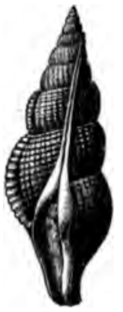
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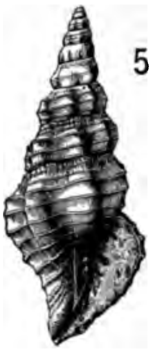
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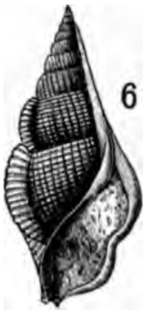
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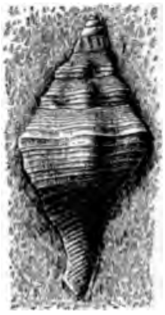
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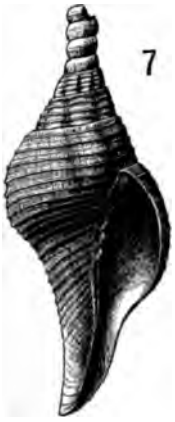
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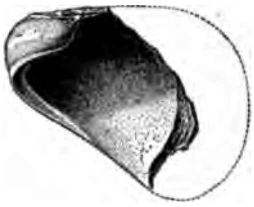
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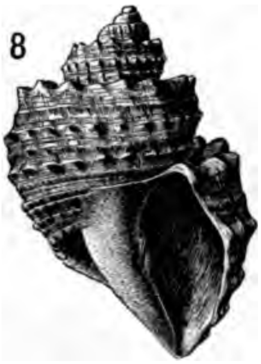
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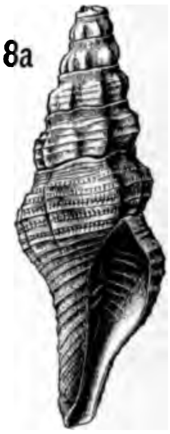
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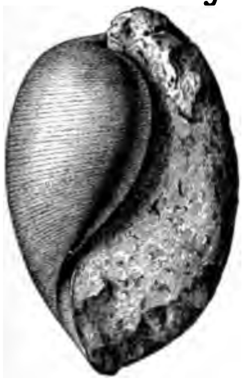
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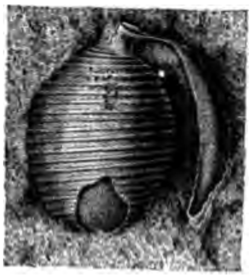
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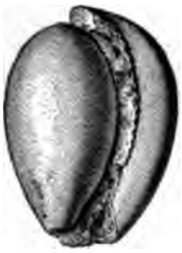
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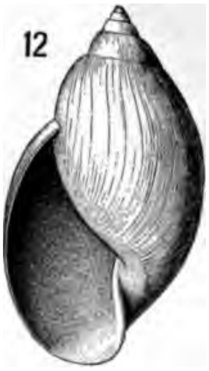
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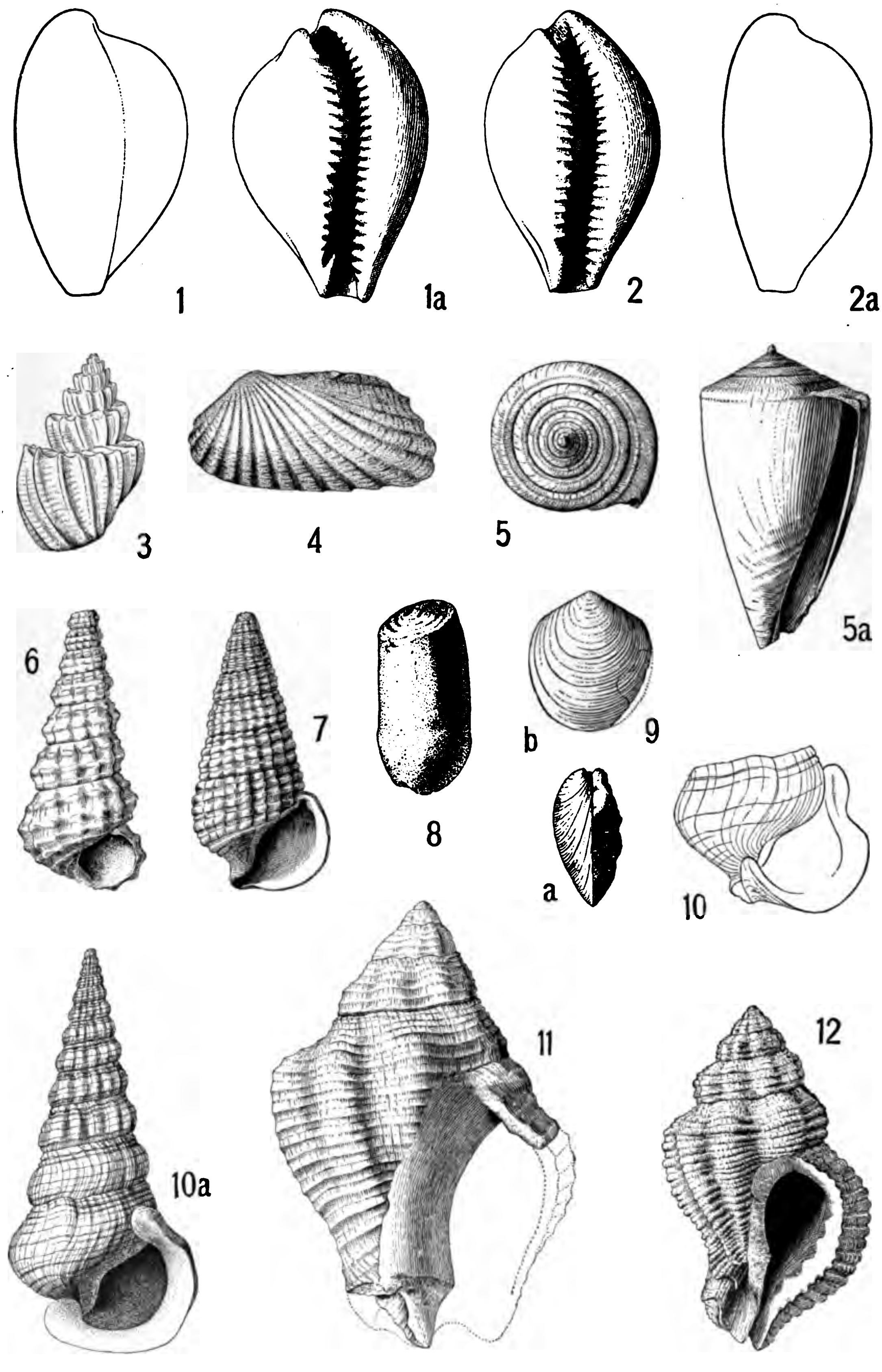

MOLLUSKS OF THE SILEX-BEDS

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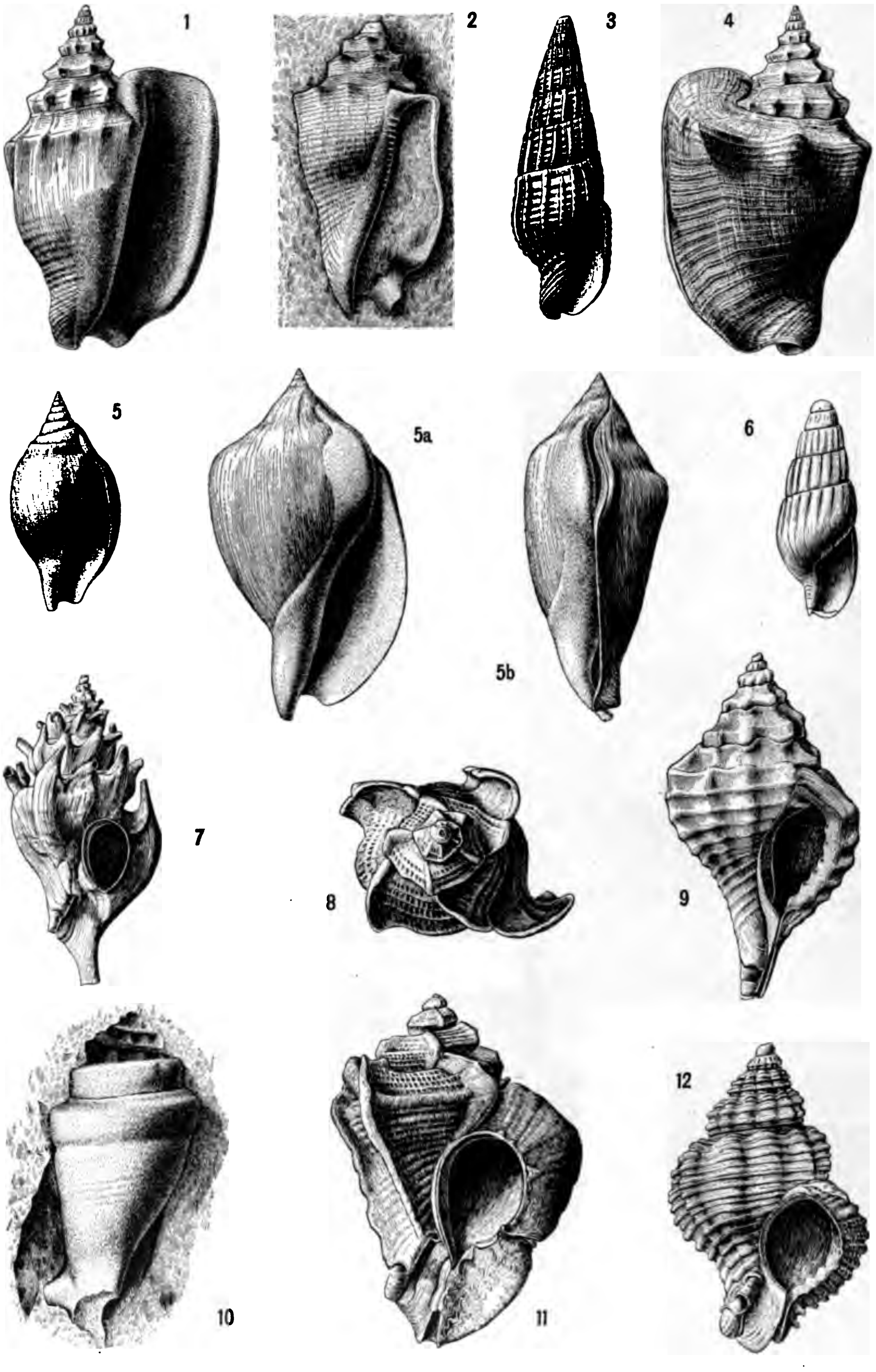

GASTROPODS OF THE FLORIDA TERTIARY.

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ERRATA.

Page 88, line 10 from the top, for "*Bandoni*" read "*Baudoni.*"

Page 104. Under *Fasciolaria Sparrowi* Emmons, the second locality, "one mile west of the Chipola River," etc., is erroneous; the locality where it was collected by Mr. Burns is the "Upper Bed, Alum Bluff, Chattahoochee River, West Florida." The fragments from White Beach cannot be positively identified, except generically.

W Browne – Leave this cove

TRANSACTIONS

OF THE

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PART II.

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CONTRIBUTIONS

TO THE

TERTIARY FAUNA OF FLORIDA,

WITH ESPECIAL REFERENCE TO THE

MIOCENE SILEX-BEDS OF TAMPA

AND THE

PLIOCENE BEDS OF THE CALOOSAHATCHIE RIVER.

BY

WILLIAM HEALEY DALL, A. M.,
Paleontologist to the U. S. Geological Survey.

PART II.

STREPTODONT AND OTHER GASTROPODS,
CONCLUDED.

WAGNER FREE INSTITUTE OF SCIENCE

OF

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PREFACE.

The following memoir by Mr. William H. Dall, of the U. S. Geological Survey, is a continuation of the subject of the Tertiary Mollusca of Florida, by the same author, which was published in Vol. 3, Part I. of these Transactions. This memoir completes the different groups except the Pelecypoda.

In addition to the collections available in the preparation of Part I., much new material has since been studied, which was obtained in later explorations by various members and correspondents of the U. S. Geological Survey; by Mr. Charles W. Johnson, Curator of the Museum of this Institution, and by the writer.

To the enumeration and description of the species actually collected, Mr. Dall has added many notes on other related fossils from the Eocene and other horizons, when it seemed desirable.

This course has been pursued with the intention of making the work more useful to students of our Tertiary fossils.

In some cases this has extended to a review of an entire group, as known from our Tertiary beds; and it is hoped that this scrutiny may result in an important advance in the revision of our Tertiary Mollusca—a work which will require the efforts of students for a long time to bring to a satisfactory completion.

To Major J. W. Powell, Director of the U. S. Geological Survey; to various members of the Survey and obliging correspondents, and to the authorities of the Smithsonian Institution and the U. S. National Museum our thanks are due for assistance rendered in the prosecution of the present investigation.

We are also indebted to the U. S. Geological Survey for authority to reproduce and use the geological map of Florida which appears in this volume, and which was recently issued as one of the illustrations to Bulletin 84 of the U. S. Geological Survey, in which the present state of our knowledge of the geology of that State is fully discussed.

JOSEPH WILLCOX.

PHILADELPHIA, December 12, 1892.

Tertiary Mollusks of Florida.

BY W. H. DALL.

PART II.

INTRODUCTORY.

On the Marine Pliocene Beds of the Carolinas.

In discussing the fine Pliocene fauna of the Caloosahatchie, it has been necessary to consider the other American faunas supposed to be of the same age or which have been referred by various authors to the same geological epoch. Omitting the beds of this age south of the Rio Grande and in the Antilles, and exclusive of the Pliocene beds of the Pacific Coast, the Caloosahatchie beds are the only marine Pliocene deposits of the United States of which the geological age has been admitted without controversy since they were first described. They were stated by Professor Heilprin,[1] in his original paper, to " give us the first unequivocal evidences of the existence of a marine Pliocene formation in the United States east of the Pacific slope," and therefore may fairly be regarded as constituting for this country the standard by which other beds, for which a similar age is claimed, should be tested.

In the earlier publications on geology and paleontology which were made in this country, the word Pliocene was used to cover the Tertiary formations subsequent to the Eocene, and the use of the word Miocene was of later date. After the nomenclature of the Tertiary, as at present understood, had been accepted by American geologists, the application of these terms became a subject of some difference of opinion, owing to imperfect knowledge of the faunas and the different points from which the subject was viewed by geologists. In general, the percentage of living forms contained in the beds, after the method of Deshayes and Lyell, was taken as decisive of the place the horizon should occupy in the scale of the Tertiary.

The area where marine Pliocene might be expected to occur is bounded on the north by part of Virginia, and extends southward along the coast to the peninsula of South Florida.

Portions of the Tertiary belt along this coast have been subjected to considerable changes of level, denudation, and obscuration by the accumulation of Pleistocene sands. Over much of the rest the Post-Eocene beds lie unconsolidated in the form of marl or shelly gravel, little elevated above the sea or the flood-line of the rivers which cross it on their way to the ocean. In an

[1] These Transactions, Vol. I., p. 64 B.

undenuded region between St. Augustine and Chesapeake Bay the Pliocene, if any, was to be looked for.

The deposits in question consist in general of isolated patches of marl[1] lying in depressions or over low areas of the Eocene or Cretaceous rocks.

These marls differ from the Miocene beds of Virginia in the greater percentage of lime which they generally contain. Paleontologically the difference was supposed to be equally great. According to Tuomey (op. cit., p. 183) and Heilprin (op. cit., pp. 51 to 53 and 60 to 61), the proportion of recent to extinct species in the Carolinian fauna is more than double that which occurs in the Miocene of Virginia. Though Holmes,[2] Ruffin,[3] Lyell,[4] and Conrad[5] regarded the Carolinian beds as Miocene, the facts above mentioned led Tuomey[6] to refer the beds to the Pliocene—a view maintained later by Tuomey and Holmes in their work on the Pliocene of South Carolina.[7] In view of the presence of sundry characteristic Miocene species in the fauna described by Tuomey, the most prominent student of our Tertiaries, T. A. Conrad, refused to regard the beds as other than Miocene, though possibly as a later series than the Miocene of Virginia and Maryland, and this opinion has been accepted by subsequent students until very recently. In short, the fauna described by Tuomey and Holmes has been regarded as a transition fauna, or " Upper Atlantic Miocene,"[8] up to within the past few years. The question as to whether it was a natural fauna at all was not, apparently, raised by any one; and, until the discovery of the Caloosahatchie beds, it could not have been successfully raised (except by a re-examination of the beds on the spot) for want of an indisputable standard of comparison.

Dana, in his " Manual of Geology,"[9] hardly touches upon the question, but, dividing the period of the American Tertiary into epochs of time, he names the last " Sumter, or that of the beds of Sumter and Darlington districts of South Carolina, in which forty to sixty per cent. of the fossils are living species; called also Pliocene." To this supposed fauna Heilprin,[10] in 1884, applied the name of " Carolinian or Upper Atlantic Miocene," in contradistinction to the Miocene beds of Virginia and Maryland, comprehended in their time relations by the " Yorktown epoch of Dana."

In his study of the Floridian Tertiary, and the comparisons which it made necessary, the writer was rapidly forced to the conclusion that the fauna catalogued and illustrated by Tuomey and Holmes in their " Pleiocene Fossils of South Carolina " was not a true fauna at all, but a confusion of

[1] Tuomey, Geol. of South Carolina, p. 171, 1848; Heilprin, Tertiary Geol. of the U. S., p. 21, 1884.
[2] Notes on the Geol. of Charleston, S. C., p. 4, 1849.
[3] Agricultural Survey of South Carolina, p. 27, 1843.
[4] Quarterly Journal Geol. Soc. of London, Vol. I., p. 413, 1845.
[5] Medial Tertiary Formation of the U. S., Introduction, page v., 1838.
[6] Geol. of South Carolina, p. 171, 1848.
[7] Pleiocene Fossils of South Carolina. Charleston, S. C. Russell and Jones, 1857. Introduction, pp. ix.-x.
[8] Heilprin, Tert. Geol. U. S., pp. 64-66, 1884.
[9] Edition of 1863, p. 506.
[10] Tertiary Geol. U. S., p. 67, 1884.

several distinct faunas, of which one was of true Miocene age, like the Virginia Miocene, while another might reasonably be regarded as genuine Pliocene, and the stratigraphical equivalent in South Carolina of the Caloosahatchie beds of Florida. This opinion was frankly stated in the introductory remarks prefaced to Part I. of this paper (p. 1), but the arguments by which it was sustained were reserved for the geological summary with which this memoir will be closed, in the hope that additional information of a positive character might be received.

In the review of the Post-Eocene Tertiaries of the United States, submitted for publication as Bulletin 84 of the U. S. Geological Survey in July, 1891,[1] the present writer used the following language:

> " In South Carolina as in North Carolina paleontologists have been confronted with a difficulty arising from the alleged co-existence in the same beds of fossil mollusks elsewhere characteristic of different formations. In the fine work on the Pliocene of South Carolina by Messrs. Tuomey and Holmes, both Miocene and Pliocene species are included, with the result that, by some authors, the whole fauna has been regarded as Miocene, and by others, including the writers of the work in question, as Pliocene. Both conclusions rest on the assumption that all the species referred to have been derived from the matrix of a single horizon, although collected at a number of different localities. This assumption appears insufficiently supported by the facts, since no critical stratigraphic investigation of the beds in question has ever been made, and especially no researches directed to the solution of this particular series of discrepancies. It may, however, be assumed that no very obvious stratigraphical differences, if any, exist, since otherwise it would seem as if they must have compelled recognition before now. The shell marl from which the fossils in question have been derived, in part, at least, exists as patches of relatively small extent, occupying shallow depressions in older deposits, which, as well as the marl and the superincumbent sands, are unconsolidated, loose, and liable to more or less shifting. The action of the torrential rains which annually visit this region, the influences at work in subaërial denudation, freshets and floods, as well as the earthquakes which occasionally disturb the soil, offer means by no means inadequate to the confusion of thin, superficial, incoherent strata of similar constitution already in contact with one another—at least to an extent which would make it extremely difficult to recognize any distinction of age or stratification on a casual examination. There is, of course, no reason why, in this State, as elsewhere, some species originating in the Miocene should not persist to the Pliocene, or even to the present fauna, essentially unchanged; as they are known to do in Florida, for instance. If this were all, no question need be raised as to the synchronous existence of species which have been collected from these beds. But this is not the real question; on the contrary, it is entirely beside the point. What we find in the supposed fauna of Messrs. Tuomey and Holmes is an aggregation of species of which some have (both north and south of this State) a definite stratigraphical position in certain Miocene beds where they have never been found associated with certain others, as in the South Carolina deposits. These others, again, are known to be associated in beds of Pliocene age from which the above-mentioned Miocene types have never been collected. Lastly, the known order of development deduced from the succession of these forms—in regions where, as in Florida, the stratigraphical succession is unquestioned, complete and distinct—is violated by their alleged contemporaneous existence in a locality so nearly adjacent.
>
> "Now, it seems to the writer that the supposition that the so-called Pliocene of South Carolina represents a mechanical mixture of species of two horizons, is more in harmony with what is known and with paleontological experience than the view that these species, elsewhere diversely distinctive, are, in this locality and for this occasion only, biosynchronous. At least it would seem as if the *onus probandi* lies with those who would claim a normally transitional character for these beds.

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[1] Now in press.

"Another fact bearing directly on this question is the lesser Pliocene and Post-Pliocene change of level in South Carolina. The level of the Columbian (Quaternary) perezone above the sea is here less elevated than it is either north or south of South Carolina. The offshore deep-sea soundings show that the sea-bottom rises, in an east-west general direction, off that State, so that the Gulf Stream flows up and over a hill or ridge[1] transverse to its course. This indicates a relatively stationary axis or wide fold here over which the Miocene beds are thin, because it was not greatly depressed, and the following Pliocene beds may be supposed to also have been extremely thin—a state of affairs, considering the incoherence of the beds, which would greatly have facilitated subsequent confusion of the fossils, and mixture of the material of the beds.

"These fossiliferous deposits are mainly confined to the northeastern part of the State. In Horry District, slight exposures were noted by Tuomey[2] on Little River; better ones were seen along the Waccamaw, for some distance from Conway borough. At Porter's Landing and at Harper's the strata appear as follows:

30′-40′	Yellow sand.
8′-12′	Yellow fossiliferous marl.
8′	Cretaceous beds

"On the right bank of the river, not far from Nixonville, the beds as exposed stand thus:

30′	Loose sand and clay.
10′	Marl
2′	Cretaceous, *Exogyra costata*.

"From these and other less important exposures on the Waccamaw, Tuomey enumerates 49 species of mollusca, of which he regards 28 as extinct."

These views having been communicated to Mr. Joseph Willcox, of Philadelphia, that gentleman, with the assistance of Mr. Charles W. Johnson, assistant curator of the museum of the Wagner Free Institute of Science, undertook to contribute to the solution of this interesting problem. In the autumn of 1891 Mr. Johnson, under the direction of Mr. Willcox, after conferring with the writer, undertook the search for genuine Pliocene beds in South Carolina. It was thought that the search would be most likely to be successful on the Waccamaw River and vicinity, a majority of Tuomey's really Pliocene species having come from that region, while the seaward position of it relative to the known Miocene of the State enhanced this probability.

The following is a summary of Mr. Johnson's report, on his investigations:

The banks of the Waccamaw River are, for the most part low, and in the thirty-six miles examined there were only three places where specimens could be obtained. About four miles above Conway is Grissett's Landing, but the supply of fossils being represented as small, Mr. Johnson did not delay here. An approximate section at the landing gave:

Soil, 4 to 5 feet.
Shell marl, 2 to 3 feet.
Blue (Cretaceous) marl, 4 feet to the water.

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[1] To this rise or fold in the sea-bottom the writer has applied the name of the Great Carolinian Ridge.

[2] M. Tuomey, Geol. South Carolina, p. 173, 1848.

The first locality of importance is at Mr. Wm. Nixon's (called Harper's Landing by Tuomey), about fifteen miles from Conway by the river, and half that distance in a direct line. Here the following section was taken :

Soil and ferruginous sand, about 20 feet.
Shell marl (the lower 4 feet much decomposed), 11 feet.
Blue (Cretaceous) marl without fossils, 8 feet.

Three miles above this is Nixonville, or Grahamville, near which is Tilly's Lake, a tributary of the Waccamaw. Near the mouth are some very important outcrops, giving the following section :

Soil and ferruginous sand, about 20 feet.
Shell marl (Pliocene), 9 to 10 feet.
Blue (Cretaceous) marl with *Exogyra costata*, 2½ feet.

Exogyra occurred in the Pliocene marl to the height of a foot above the level of the blue marl, being, of course, adventitious.

At Bear Bluff, about six miles above the lake, is an outcrop of decomposed shell marl about six feet thick, but affording little in the way of fossils

The next place of importance is Todd's Ferry, which is probably the locality cited by Tuomey under the name of Royal Ferry. It is about twelve miles from Conway by land, but nearly three times as far by the tortuous course of the river. Here were found :

Soil, 4 to 6 feet.
Shell marl, lower half much decomposed, 8 feet.
Sand with *Pecten eboreus* and *Ostrea meridionalis*, 3 feet.

The Cretaceous was not visible here. Two miles above is Red Bluff, where the marl is so indurated as to afford few specimens, but they were identical with those previously found. The following section was made :

Soil and ferruginous sand, about 10 feet.
Indurated shell marl, 5 feet.

The lower decomposed marl appears to be identical with the upper part of the bed, for at Tilly's Lake, where they were best preserved, the same species were found in both parts of the bed.

After completing his collections on the Waccamaw, Mr. Johnson proceeded to the estuary of the Neuse River, in North Carolina. At Mr. Mallison's place, thirteen miles below New Berne, N. C., the following section was obtained, the strata dipping slightly seaward:

Soil and ferruginous sand, 10 feet.
Ferruginous sandy clay, 10 to 12 feet.
Bluish clay with fossils (Pliocene), 5 to 6 feet.

At the mouth of Slocum's Creek, fifteen miles below New Berne, the formation was similar, except that the more arenaceous character of the shell-bed better facilitated collecting. Here the section was:

Soil and ferruginous sand, 10 feet.
Ferruginous sandy clay, 10 feet.
Blue sandy clay and yellow sand with shells, 4 to 5 feet.

These beds on the Neuse were referred by Kerr to the Quaternary,[1] under the mistaken impression that the fossils contained in them were all of recent species. It is probable that other beds of this sort occur near Cape Fear and near the shores of the Sound, by Beaufort and east of the Pungo and Chowan Rivers, judging from incidental remarks by Kerr and Emmons, and the nature of the fossils described by Emmons and by Conrad. The latter boldly refers[2] "all those strata of sand and clay which border the Atlantic from Cumberland County, New Jersey, to the middle of South Carolina" to the "Miocene Age."

The discussion of the species in the beds above referred to is beset with difficulty. The original method of determining the nomenclature of a division of the Tertiary—by the percentage of living and extinct species of fossils contained in them—has been practically abandoned. Tuomey reckoned that 42 per cent. of the species in his (composite) Pliocene were still found recent, yet this did not prevent Conrad and Heilprin from regarding the beds as Miocene.

Since these authorities discussed the subject, the researches of the U. S. Fish Commission have shown that a considerably larger number of them are still living a short distance off shore, in less than 100 feet of water. A more careful discrimination and comparison of the recent and fossil species shows beyond question that the range of many species in time is far greater than was formerly supposed, and that some species are still living which had assumed their present characters in the Eocene. The comparison of the fauna by parallelism with beds of known and admitted Miocene or Pliocene age, as those terms have come to be used, is the plan to which we must resort. Yet this is by no means easy, since large numbers of our so-called Miocene species, and especially those with which these forms would be best compared, have been described and catalogued without that particularity of location which alone would enable us to decide whether their Miocene character was really beyond dispute. I have been obliged, therefore, in the assignments of age tabulated below, to depend upon collections of more recent date for decision on such points; and as quite a number of species are still to be precisely located, the results are liable, with further information, to be slightly modified. In the present case, however, the evidence is so strong that it would seem that such modifications, in any event, could not change the main conclusions to which the study of the fauna has led me.

In the publication to which I have already referred,[3] I have endeavored to correlate the names heretofore assigned to the subdivisions of our Tertiary, with the physical changes which are indicated by the stratigraphic and faunal unconformities which characterize them. The continuity of deposition in the

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[1] Report of the Geol. Survey of North Carolina, p. 155, 1875.

[2] Rep. Geol. Surv. N. C., 1875, App. A, p. 24.

[3] Bull 84, U. S. Geol. Survey. In press

Floridian region has contributed greatly toward the apparent success of this attempt.

The close of the Eocene was marked by a movement in elevation which raised Central Florida as an island above the level of the sea, separated by a wide strait from the continental shore-line of Georgia. At the same time a change of conditions took place by which the character of the fauna was subjected to a notable alteration. *Nummulites* and *Orbitoides*, genera which had formed until then most conspicuous members of the fauna, together with other foraminifera of smaller size, disappeared entirely, with numerous molluscan genera, and were replaced by others, notably *Orbitolites*. The fauna was a subtropical assemblage similar to that of the Central Antilles, and this continued for a time to be its character. Orogenic changes elsewhere intervened, and, probably by modifying the course of the ocean-currents, affected the character of the Floridian fauna even more profoundly than did those changes which terminated the Eocene.

The period between the inception of the Miocene and the modification of its original fauna covered the deposition of the beds comprising the Chattahoochee group of Langdon and the Tampa group of Dall, and, from the fact that its warm-water fauna is best displayed in the Chipola beds of Northwest Florida, along the river of the same name, may be called the *Chipola epoch*. During this epoch subtropical mollusks, such as *Cymia* and *Voluta*, flourished as far north as New Jersey. The temperature-indications of the fauna do not differ essentially, as far as our knowledge goes, from those of the previous later Eocene fauna. At no succeeding epoch do we find subtropical or tropical mollusks extending northward to such a distance from their present range. If any of the leaf-beds of Greenland are really Miocene, these facts authorize the suspicion that the period when walnuts ripened on the shores of the Arctic Sea may have been synchronous with the warm Chipola epoch of the early Miocene.

Whether an eastward deflection of the Gulf Stream, connected with elevation of the Great Carolinian Ridge, or some other undetermined cause, offered the opportunity, a colder inshore current seems to have crept southward along the continent, penetrated the strait between Georgia and Florida, and washed the northern shores of the Gulf of Mexico. With it came the cold-water fauna appropriate to its temperature. This fauna began early in the north, nearly the whole mass of the New Jersey, Maryland and Virginia Miocene being of this character. Southward, the mass relative to that of the Chipola epoch gradually diminishes, being less in the Carolinas and least in the Floridian region. With this fauna were introduced the conspicuous forms which are known as characteristic of the Miocene of Maryland and Virginia, the large Pectens and Arcas, *Venus* and *Ecphora*. Profusely developed about Chesapeake Bay, where it is found in those beds to which Darton and the writer, independently, came to apply the name of Chesapeake, the period in which it flourished may appropriately be designated as the *Chesapeake epoch.* The fauna introduced at this time has left lasting traces on the fauna of the Gulf of Mexico even to the present moment, but never reached as far south as the Florida Keys or the southern portion of the peninsula. The faunal change was decidedly the most important mutation which is traceable in the fossil invertebrate faunas of the Gulf and Floridian region during the whole of Post-Eocene time.

The Chipola epoch here, in general, was a period of very slow and gentle elevation, followed at or near its close by a slight depression equally gentle.

The Chesapeake epoch in the South was in the main a period of quiescent deposition, and was closed by a very important movement in elevation. In the Central American region (notably Costa Rica), the Miocene rocks were elevated to a height of 12,000 feet above the sea. The Panamic connections between the Caribbean Sea and the Pacific Ocean were definitely terminated, and the connection between the continents of North and South America finally brought about. On the northern shores of the Gulf of Mexico the elevation was more moderate, but considerable, and by it the island of Florida was united to the Georgian mainland and the previously existing strait permanently closed. This event, in the classification proposed by the writer, terminates the Miocene.

The products of erosion resulting from the rising of the land were probably those laid down as the Grand Gulf beds of Hilgard and the Altamaha Grits of Georgia. The water in which they were deposited was for the most part fresh or brackish, and the littoral subsidence so gradual as to practically exclude the sea and its fauna.

The Pliocene of Eastern America, as understood by the writer, begins with the culmination of the movement in elevation just described, and ends with the beginning of the Glacial period.

The elevation on the continent resulted in the immediate increase of fluvial erosion, and the continued and accelerated creation of perezonal formations similar to the above-mentioned Grand Gulf-beds, especially the Lafayette or Appomattox formation of McGee. The discharge of immense quantities of sediment must have rendered the shores less adapted to profuse molluscan life than they had been during the Chesapeake epoch. At all events, the Chesapeake fauna seems to have receded, and to have been gradually followed up by the warm-water fauna which succeeded the Chesapeake and is preserved in the Caloosahatchie beds. As the peninsula of Florida has preserved an unbroken record of this era, it would seem appropriate to apply to it the name of the Floridian epoch, and, slightly modifying Prof. Heilprin's use of the term, to refer all deposits of similar paleontologic contents to a single assemblage in the system under the name of the Floridian group.

It is probable that the South American vertebrates, such as *Glyptodon,* which found their way northward after the union of the continents, did not immediately reach the Floridian peninsula; but, whatever their migrations, it is certain that during the Middle Pliocene they made their appearance in that region. Their bones, sandwiched between fossiliferous rocks of Pliocene age, establish this fact beyond controversy.

The invertebrates appear—in Florida, at least—to have flourished peacefully, and the extinction of some of the most conspicuous forms of the fauna appears to have been brought about by a movement in elevation which raised their favorite shallows above the sea—an elevation not necessarily of many feet in altitude. At all events, a majority of those species which live preferably in moderate depths of water, as opposed to littoral forms, still persists in similar situations, unmodified to any notable extent.

The orogenic independence and singular tranquillity of the area which originally formed the island of Florida, contrast strongly with the disturbances in elevation or depression of which both continental and Antillean geology give evidence. It would seem almost as if Florida had rested on the axis of the disturbances, and the tilting northward and southward been minimized at that point.

For the beds exhibited in South Carolina along the Waccamaw, above the Cretaceous marl, as sectionized by Tuomey and Johnson, the name of *Waccamaw beds* may be adopted. For those which are found along the estuary of the Neuse River the local Indian name of *Croatan beds* may be used. Both, as will subsequently appear, may be referred to the Floridian group or epoch. The relations of our later Tertiaries may be broadly summarized as follows:

Later Eocene.

Vicksburg group (Jackson, Vicksburg and Salt Hill formations).
Ocala group (Nummulitic beds of Florida).

MIOCENE.

Chipola Epoch.

Chattahoochee group (Hawthorne and Ocheesee beds).
Tampa group (Shiloh marl, Tampa and Chipola beds).

Chesapeake Epoch.

Chesapeake group (Maryland, Virginia, etc.).
Grand Gulf group (Grand Gulf beds, Altamaha Grit, etc.—Epoch of elevation begun and in progress).

PLIOCENE.

Floridian Epoch.

Lafayette group (Lagrange beds, Orange sand, etc.; culmination of elevation).
Floridian group (Caloosahatchie, De Soto and Waccamaw beds, etc.).

PLEISTOCENE.

Glacial Epoch.

The following tables will indicate the fauna of the beds explored by Mr. Johnson. The three columns show the range of the species in other strata—Miocene, Pliocene and Pleistocene .o recent faunas respectively.

TABLE OF SPECIES FROM THE WACCAMAW BEDS.

N.=locality at Nixon's; T.=Tilly's Lake; F.—Todd's Ferry.

	M.	P.	R.
Ostrea meridionalis, Hp. (N. T. F.)		o	
Amusium Mortoni, Conr. (F.)		o	o
Anomia simplex, Orb. (F.)		o	o
Plicatula ramosa, Lam. (N. T. F.)		o	o
Pecten eboreus, Conr. (F.)	o	o	
Pecten irradians, Lam. (N. T. F.)		o	o
Pinna carnea, Gmelin (F.)		o	o
Arca rustica, T. and H. (F.)		o	
Arca ponderosa, Say. var. limula Conr. (N. T.)	o	o	
Arca lienosa, Say. var. (N. T. F.); different from the Miocene var.		o	o
Arca transversa, Say. var. æquicostata Conr. (N. T.)		?	
Arca transversa, Say. var. improcera Conr. (N. T.)		o	o
Arca cælata, Conr. (N. T.)	o	o	o
Pectunculus pectinatus, Gmel. (N. T.)	o	o	o
Pectunculus undatus, Linn. (N. T. F.)	o	o	o
Nucula proxima, Say. (N. T.)		o	o
Leda acuta, Conr. (T.)	o	o	o
Carditamera arata, Conr. (N. T.)	o	o	
Venericardia granulata, Say. (N. T.)	o	o	o
Venericardia tridentata, Say. (N. T.)	o	o	o
Venericardia perplana, Conr. (N. T.)	o	o	o
Venericardia perplana, var. abbreviata, Conr. (N. T.)	o	o	o
Astarte castanea, Say. (T.)	o	o	o
Astarte concentrica, Conr. (N. T.)	o		
Circe metastriata, Conr. (N. T.)	o	o	o
Crassatella Gibbesii, T. and H. (N. T. F.)		o	o
Eriphyla lunulata, Conr. (N. T.)	o	o	o
Fabella constricta, Conr. (T.)	o	o	
Fabella compressa, H. C. Lea (T.); also Pleistocene.	o	o	
Lepton Kurtzii, Dall sp. n. (T.)		o	o
Divaricella quadrisulcata, Orb. (T.)	o	o	o
Lucina crenulata, Conr. (T.)	o	o	o
Lucina costata, Conr. (T.)	o	o	o
Lucina radians, Conr. (T.)	o	o	o
Lucina trisulcata, Conr. (T.)	o	o	o
Lucina anodonta, Say. (N.)	o	o	
Diplodonta acclinis, Conr. (N. T.)	o	o	
Diplodonta subglobosa, Ads. (T.)		o	o
Chama congregata, Conr. (N. T.)	o	o	o
Chama macrophylla, Lam. (F.)		o	o
Chama arcinella, Linn. (T. F.)		o	o

	M.	P.	R.
Cardium magnum, Born (N. T. F.)		o	o
Cardium floridanum, Hp. (T.)		o	
Liocardium serratum, L. var sublineatum, Conr. (N. T. F.)	o	o	o
Venus mercenaria, Linn. (N. T.)	o	o	o
V. mercenaria, var. Mortoni, Conr. (N. T.)	o	o	o
Venus cancellata, Linn. (T.)	o	o	o
Venus latilirata, Conr. (N. T. F.)	o	o	o
Venus cribraria, Conr. (N. T.)	o	o	o
Venus pygmæa, Lam. (T.)		o	o
Cytherea convexa, Say. (N. T.) [Sayana Conr.]	o	o	o
Callista gigantea, Gmel. (N. T.)	o	o	o
Gemma purpurea, H. C. Lea (T.)		o	o
Dosinia elegans, Conr. (T. F.)		o	o
Corbicula densata, Conr. (N.)	o	o	
Donax fossor, Say. (T.)		o	o
Psammobia Wagneri, Dall. (F.)		o	
Tagelus gibbus, Spgl. (F.)		o	o
Solen americanus, Gould. (N. T.)			o
Tellina arctata, Conr. (N.)	?		
Angulus tenellus, Verrill. (T.)		o	o
Abra æqualis, Say. (T.)	o	o	o
Cumingia tellinoides, Conr. (T.)	o	o	o
Semele cancellata, Orb. (N. T.)		o	o
Semele Leana, Dall n. s. (T. ?)		o	
Mactra similis, Say. (N. T.)			o
Mactra lateralis, Say. (N. T.)	o	o	o
Mactra brasiliana, Lam. (T.)		o	o
Verticordia ornata, Orb. (N.)		o	o
Paramya subovata, Conr. (T.)	o	o	o
Laubriereia æquata, Conr. (T.)	o	?	
Corbula inequale, Say. (N. T.)	o	o	
Corbula Barrattiana, C. B. Ad. (T.)		o	o
Corbula contracta, Say. (T.)		o	o
Glycimeris reflexa, Say. (N.)	o	o	o
Dentalium antillarum, Orb. (T.)		o	o
Cadulus sp. indet. (T.)		?	?
Tornatina canaliculata, Say. (N. T.)	o	o	o
Terebra dislocata, Say. (N. T. F.)	o	o	o
Terebra concava, Say. (N. T.)	o	o	o
Conus adversarius, Conr. (N. F.)	o	o	
Conus Agassizii, Dall (N. T. F.)		o	o
Drillia lunata, H. C. Lea (N.)	o	o	
Drillia tuberculata, Emmons (N. T.)	o	o	
Drillia abundans, Conr. var. (N. T. F.)		o	
Drillia ebur, Reeve (N.)		o	o
Drillia sp. indet. (N. T.)		?	
Mangilia eritima, Bush (T.)		o	o
Mangilia cerina, K. & S. (T.)		o	o
Daphnella elata, Dall (T.)		o	o
Cancellaria venusta, T. & H. (F.)		o	
Cancellaria Conradiana, Dall (F.)		o	
Oliva literata, Lam. (N. T. F.)		o	o
Olivella mutica, Say. (N. T.)	o	o	o

	M.	P.	R.
Olivella nitidula, Dillw. (N. T.)	o	o	o
Marginella denticulata, Conr. (N. T.)	o	o	o
Marginella aureocincta, Stearns (T.)	o	o	o
Marginella bella, Conr. (N. T.)	o	o	o
Marginella limatula, Conr. (N. T.)	o	o	o
Marginella precursor, Dall (N.)		o	
Marginella contracta, Conr. (N. T.)		?	
Volutella dacria, Dall, n. s. (N. T.)		?	
Volutella ovuliformis, Orb. (N. T.)		o	o
Aurinia obtusa, Emmons (N. T. F.)	o		
Mitra wandoënsis, Holmes (T.)	o	o	o
Fasciolaria apicina, Dall (N. T. F.)		o	
Fasciolaria gigantea, Kiener (N.)	o	o	o
Fasciolaria elegans, Emmons (F.)	o	?	
Fulgur carica, L. (N. T. F.)		o	o
Fulgur perversum, L. (N. T. F.)	o	o	o
Fulgur canaliculatum, Say. (N.)		o	o
Fulgur, var. pyriformis, Conr.	o	o	
Fulgur pyrum, var. excavatum (N.)	o	o	
Fusus caloosaënsis, Hp., stout var. (T.)		o	
Tritonidea auritula, Link (T.)		o	o
Nassa consensa, Rav. (N. T.)	o	o	o
Nassa acuta, Say. (N.)		o	o
Nassa obsoleta, Say. (N. T. F.)	o	o	o
Nassa isogramma, Dall, n. s.		?	
Nassa porcina, Say. (N.)	o	o	
Nassa, sp. ind. [like scalarispira, Conr.] (N.)	?		
Nassa caloosäensis, Dall (N. T.)		o	
Anachis avara, Say., var. translirata, Rav. (N. T.)			o
Anachis camax, Dall (T.)		o	
Anachis obesa, C. B. Ads. (T.)			o
Anachis ithitoma, Dall (T.)		o	
Astyris lunata, Say. (T.)		o	o
Astyris profundi, Dall (N. T.)		o	o
Astyris profundi, var. permagna, Dall (N. T.)		?	
Æsopus Stearnsii, Tryon (T.)		o	o
Pterorhytis Conradi, Dall (F.)	o		
Eupleura caudata, Say. (T.)		o	o
Muricidea floridana, Conr. (F.)		o	o
Muricidea multangula, Phil. (N. F.)		o	o
Urosalpinx cinereus, Say. (N. F.)			o
Urosalpinx perrugatus, Conr. (F.)		o	o
Coralliophila lepidota, Dall (F.)		o	
Scala angulata, Say. (T.)			o
Scala turricula, Say. (T.)		o	o
Scala multistriata, Say (T.)			o
Eulima conoidea, K. and S.	o	o	o
Eulima intermedia, Cantr. (T.)		o	o
Eulima gracilis, C. B. Ads. (T.)		o	o
Niso ægleës, Bush (T.)			o
Turbonilla reticulata, C. B. Ads. (T.)		o	o
Turbonilla multicostata, C. B. Ads. (T.)		o	o
Turbonilla interrupta, Tott. (T.)		o	o

	M.	P.	R.
Odostomia seminuda, C. B. Ads. (T.)		o	o
Ondina fragilis, Dall n. s.		?	
Pyrula papyratia, Say (N. F.)		o	o
Trivia suffusa, Gray (T.)	o	o	o
Erato maugeriæ, Gray (T.)		o	o
Triforis nigrocincta, C. B. Ads. (T.)		o	o
Seila terebralis, C. B. Ads. (T.)	o	o	o
Cæcum pulchellum, Stm. (T.)		o	o
Cæcum Cooperi, Smith (T.)		o	o
Cæcum carolinianum, Dall (T.)		o	o
Cæcum ibex, Dall n. s. (T.)		?	
Petaloconchus 2 sp. indet. (T.)		?	?
Turritella subannulata, Hp. (N. T.)		o	
Litorina irrorata, Say (T.)	o	o	o
Adeorbis Orbignyi, Fischer (T.)	o	o	o
Crucibulum striatum, Say (N. T.)		o	o
Crepidula fornicata, Linné (N. T. F.)		o	o
Crepidula convexa, Say (N. T.)		o	o
Crepidula plana, Say (N. T.)		o	o
Crepidula aculeata, Gmel. (N. T. F.)		o	o
Neverita duplicata, Say (N. T. F.)	o	o	o
Lunatia heroica, Dall n. s. (T. F.) [heros auct. exparte, non Say]	o	o	
Natica canrena, Lam. (T. F.)	o	o	o
Natica pusilla, Say (N. T.)	o	o	o
Sigaretus multiplicatus, Dall n. s. (T.)		o	
Phasianella pulchella, C. B. Ads. (T.)			o
Turbo crenulatus, Gmelin (T.)		o	o
Calliostoma jujubinum, Gmelin (T.)		o	o
Calliostoma n. s.? (T.) [like philanthropus Conr.]		?	
Liotia tricarinata, Stearns (T.)	o	o	o
Rimula Caroliniana, Dall n. s. (T.)		?	
Fissuridea alternata, Say (N. T.)		o	o

TABLE OF SPECIES FROM THE CROATAN BEDS OF THE NEUSE RIVER.

S.=Slocum's Creek locality; M.=Mallison's. The column headed "R" includes both Pleistocene and the existing fauna.

	M.	P.	R.
Ostrea meridionalis, Heilprin (S.)		o	
Anomia simplex, Orb. (S. M.)		o	o
Plicatula ramosa, Lam. (S.)		o	o
Pecten dislocatus, Say (S. M.)		o	o
Modiola plicatula, Lam. (S.)			o
Arca pexata, Say (S. M.)		o	o
Arca cælata, Conr. (A. Adamsi Shutt. S. M.)	o	o	o
Arca ponderosa, Say (S.); typical.			o
Arca ponderosa var. limula, Conr. (S. M.)	o	o	
Arca subsinuata, Conr. (S. M.)		?	
Arca transversa, Say, var. æquicostata, Conr. (S. M.)		?	
Arca transversa, Say, var. plicatura, Conr. (S. M.)	o	o	
Pectunculus pectinatus, Gmel. (S.)	o	o	o
Pectunculus parilis, Conr. (S.)	o	o	
Yoldia limatula, Say (S. M.)	o	o	o

	M.	P.	R.
Leda acuta, Conr. (S. M.)	o	o	o
Carditamera arata, Conr. (S. M.)	o	o	
Venericardia tridentata, Say (S. M.)	o	o	o
Venericardia perplana, Conr. (S.)	o	o	o
Venericardia perplana, var. abbreviata, Conr. (S.)	o	o	o
Eriphyla lunulata, Conr. (S.)	o	o	o
Fabella compressa, H. C. Lea (S.) ; also Pleistocene.	o	o	
Lucina crenulata, Conr. (S. M.)	o	o	o
Lucina costata, Conr. (S.)	o	o	o
Diplodonta subglobosa, C. B. Ad. (S. M.)		o	o
Chama congregata, Conr. (S.)	o	o	o
Cardium magnum, Born (S)		o	o
Venus mercenaria, L. (S.)	o	o	o
Venus mercenaria, var. Mortoni, Conr. (S.)	o	o	o
Cytherea Sayana, Conr. (S.) [convexa, Say.]	o	o	o
Corbicula densata, Conr. (S.)	o	o	
Donax fossor, Say (S.)		o	o
Tagelus divisus, Spengl. (M.)		o	o
Solen americanus, Gld. (S. M.)			o
Tellina æquistriata, Say. (S.)	o	o	
Tellina alternata, Say (M.)		o	o
Angulus politus, Say (S)		o	o
Abra æqualis, Say (S. M.)	o	o	o
Cumingia tellinoides, Conr. (S.)	o	o	o
Gnathodon Grayi, Conr. (S. M.)		o	o
Mactra lateralis, Say (S. M.)	o	o	o
Mactra congesta, Conr. (S. M.)	o		
Labiosa canaliculata, Say (M.)			o
Clidiophora trilineata, Say (S.)			o
Paramya subovata, Conr (S.)	o	o	o
Corbula contracta, Say (S. M.)		o	o
Gastrochæna cuneiformis, Spengl. (S.)		o	o
Pholas costata, L. (M.)		o	o
Martesia cuneiformis, Say (M.)		o	o
Actaeon punctostriatus, Ad. (S.)	o	o	o
Tornatina canaliculata, Say (S. M.)	o	o	o
Terebra dislocata, Say (S. M.)	o	o	o
Terebra concava, Say (M.)	o	o	o
Drillia tuberculata, Emmons (S.) [eburnea Dall non Conr.]	o	o	
Mangilia rubella, K. & S. (S.)		o	o
Mangilia eritima, Bush (S.)		o	o
Olivella nitidula, Dillw. (S.)	o	o	o
Olivella mutica, Say (S. M.)	o	o	o
Marginella bella, Conr.	o	o	o
Marginella virginiana, Conr. (S.)	o	o	o
Marginella (apicina var.) borealis Ver. (S. M.)			o
Marginella aureocincta, Stearns (S.)	o	o	o
Volutella dacria, Dall n. s. (S.)		?	
Aurinia ? obtusa, Emmons (M.)	o		
Mitra wandoensis, Holmes (S.)	o	o	o
Fulgur carica, L. (S. M.)		o	o
Fulgur perversum, L. Young (S.)	o	o	o
Fulgur canaliculatum, Say (S. M.)		o	o

	M.	P.	R.
Nassa acuta, Say (S. M.)		o	o
Nassa trivittata, Say (S. M.)		o	o
Nassa vibex, Say (S.)		o	o
Ilyanassa obsoleta, Say (S. M.)	o	o	o
Anachis avara, Say, var. semiplicata, Stearns (S. M.)			o
Anachis camax, Dall (S.)		o	
Anachis obesa, C. B. Ads. (S. M.)			o
Astyris lunata, Say (S. M.)		o	o
Eupleura caudata, Say (S.)		o	o
Urosalpinx cinereus, Say (S. M.)			o
Scala lineata, Say (S.)		o	o
Scala angulata, Say (S. M.)			o
Eulima conoidea, K. & S. (S)	o	o	o
Pyramidella arenosa, Conr. (S.)	o	o	o
Turbonilla reticulata, C. B. Ads. (S. M.)		o	o
Turbonilla multicostata, C. B. Ads. (S.)		o	o
Turbonilla interrupta, Totten (S.)		o	o
Turbonilla punicea, Dall (S.)			o
Odostomia seminuda, C. B. Ads. (S.)		o	o
Seila terebralis, C. B. Ads. (S.)	o	o	o
Vermicularia spirata, Phil. (M.)		o	o
Crepidula convexa, Say (S. M.)		o	o
Crepidula fornicata, Linné (M.)		o	o
Crepidula plana, Say (S. M.)		o	o
Neverita duplicata, Say (S. M.)	o	o	o
Natica pusilla, Say (S. M.)	o	o	o
Calliostoma erosum Dall, n. sp. (S.)		?	
Fissuridea alternata, Say (S. M.)		o	o

In the discussion of these tables, if we adopt the old-fashioned method, it appears that, throwing all the doubtful species into the category of extinct forms, we have from the Waccamaw beds 125 out of 180 species still found living, or about 70 per cent.; while from the Croatan beds we have 80 out of 96 species represented in the recent fauna, or over 83 per cent. By this method the Pliocene character of the beds is obvious, according to the numerical rule.

If, however, we prefer to adopt the more modern and rational method of a comparison with standard faunas, we arrive at practically the same result. Of the 180 species of the Waccamaw beds, 2 have been hitherto regarded as strictly Miocene, 16 are known as common to Miocene and Pliocene faunas elsewhere, 17 are characteristic of Pliocene faunas elsewhere; 7 are new to science, and 13 are of doubtful or contestable range. Of the remainder, 51 are known to be common to Miocene, Pliocene and recent faunas, 64 to Pliocene and recent faunas, and 9 have hitherto been known only in the recent state.

Eliminating the 51 uncharacteristic species, together with 20 which are doubtful or new, we have remaining 109 species, of which 2 have been known only as Miocene, 17 only as Pliocene, and 9 as recent; or 90 which are known as only Pliocene, or younger, against 18 which are regarded as only Pliocene and older.

In the case of the Croatan beds we find 35 uncharacteristic (Miocene to recent) species, with 6 new or doubtful forms. We have 2 characteristic Pliocene species and 11 hitherto known as recent. Of the 55 with known range, 47 are known as Pliocene or younger, and 8 as of Pliocene or older horizons.

By this method, therefore, no doubt can arise as to the non-Miocene character of both these faunas, and no one is likely to regard the Waccamaw beds as Pleistocene. The Croatan beds are obviously newer than those of the Waccamaw, yet when compared with the admitted Pleistocene beds of South Carolina, such as those of Simmons's Bluff, the presence on the Neuse of 41 out of 96 species which have not been known later than the Pliocene forbids us to regard the fauna as later than Pliocene.

It should be explained that reference to the literature as it stands would show apparent discrepancies between these figures and the records. But the comparisons have not been made by the books, but by the specimens. The Carolinian forms have been compared with those from the Caloosahatchie and Chipola beds, or with the fauna of the Natural Well in Duplin County, N. C., and of Petersburg, Va.

This is, in fact, the only safe way of arriving at a reliable conclusion. When we remember that many of the species from the very beds under investigation have been described as Miocene by Emmons and Conrad, and inserted in their Miocene lists; that scores of the older species have been described simply as " Miocene, Virginia " or " Miocene, North Carolina," with no other indication of horizon, or exact locality, than the assumptions of the original describer, we cannot fail to recognize that any discussion of the relations of the fauna based upon the literature alone would be in the highest degree inconclusive.

It is highly probable that, when our knowledge of the range of our Tertiary species is more complete, it will be found that the cited ranges will be extended in many cases from those given in the tables. But there is no reason to suppose that the main conclusion, to which the foregoing discussion has led us, will be seriously affected by such changes. We may now assert with confidence that—1, the presence of genuine Pliocene beds has been established in both the Carolina's; 2, the Pliocene of Tuomey and Holmes has been shown to be a confusion of species belonging to at least two horizons; and 3, that the classifications based upon the supposed characteristics of this non-existent fauna may now be consigned to oblivion, or at least removed from the geologic pathway in which they have been so long a stumbling-block. That their biological anomalies enabled the writer practically to predict this result is satisfactory testimony to the value of paleontology in geological work—a value which some modern writers have too hastily called in question.

These results, however, do not justify the assumption of the non-existence of any transition beds between the Chesapeake and Lafayette groups. Theoretically such beds must exist unless they have been destroyed by erosion; and in fact data pointing to their existence in North Carolina, and possibly farther South, are in my possession, but are yet not sufficiently conclusive for publication. In view of the confusion which has hitherto existed, it seems necessary to use caution and to await careful stratigraphical details before proceeding to final conclusions.

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Mr. Geo. H. Eldridge, Mr. Jussen and Mr. G. D. Harris, of the United States Geological Survey, have facilitated the work at various times; and to the officers of the Academy of Natural Sciences, especially Mr. Pilsbry and Prof. Heilprin, the writer is indebted for courtesies on several occasions, for which he desires to express his sincere thanks.

NOTE ON THE SYSTEMATIC DISCUSSION OF THE SPECIES.

Since beginning work on this report, so much interest and energy has been expended by Mr. Joseph Willcox, Mr. Chas. W. Johnson, of the Wagner Institute, and other correspondents and friends, that box after box of material has arrived, and the manuscript has been repeatedly rearranged to accommodate the notes and descriptions rendered necessary by these additional researches.

It has been thought best to arrange the additional material received since the printing of Part I. in its zoological order in the present paper, rather than break the continuity by relegating the whole to an appendix. The material not touched upon in Part I. will be continued without any break to the conclusion of the Gastropods. Part III., it is hoped, will contain the Pelecypods, together with a general summary and tables.

In explanation of the slow progress of this work, it should be stated that the whole is done in the intervals of official work, and that upon the occurrence of such intervals its progress entirely depends. Much of the writer's time during the past three years has been taken up in the official preparation of a general account of the "Neocene" or Post-Eocene Tertiary of the United States, which has recently been issued by the United States Geological Survey as Bulletin of the Survey No. 84. This paper contains, with a geological map of Florida, a discussion of the relations of the beds which would assist the reader to understand the distribution of the fossils described in the present report and the relations of the several beds referred to. Until Part III. of this report is printed, such geological data as the reader may need can be obtained from the above-mentioned bulletin.

In order to avoid confusion in the references to plates, index, etc., when the different parts of this report shall be bound together, as may frequently happen, the pagination of this volume and the numeration of the plates are severally continuous to those of Part I.; the pagination of Volume III., Part 2 beginning with page 201, while the first plate is numbered 13, the last page of Volume III., Part 1 having been 200 and the last plate No. 12.

Washington, July, 1892.

TERTIARY MOLLUSKS OF FLORIDA.

PART I.

GASTROPODA,

CONTINUED AND CONCLUDED; TOGETHER WITH ADDITIONS TO THAT PART OF THE FAUNA DISCUSSED IN PART I.

Order OPISTHOBRANCHIATA.

FAMILY BULLIDÆ (supplementary).

Bulla striata Brug. var. **attenuata** Dall.

Plate 13, figure 10 a.

Habitat, Pliocene of Shell Creek, Willcox.

Among the specimens of this common species obtained at Shell Creek were a number which at first seemed as if they must certainly belong to a different species. I have come to the conclusion that they are merely a variety of the ordinary form; but they present such marked characters that it has seemed well to illustrate them. This variety differs from the common form of *striata* by being distinctly attenuated behind, by the presence at the posterior extreme of four or five sharp spiral grooves even more prominent than those near the pillar, and by the much larger size of the apical pit, whose walls are distinctly spirally grooved. Intermediate specimens, however, do occur, and therefore this form can only take rank as a variety. I have not found in a large series of recent specimens any exactly comparable to it.

FAMILY TORNATINIDÆ (supplementary).

Utriculus vaginatus Dall.

Plate 20, figure 2.

This species, described in Part I. (p. 16), is figured from a young specimen obtained from Ballast Point. The adult is proportionately broader and squarer in form, but otherwise does not materially differ.

Order CTENOBRANCHIATA.

FAMILY CONIDÆ (supplementary).

Conus planiceps Heilprin.

Part i. p. 25, pl. 11, figures 5, 5 a.

This species has since turned up at Bailey's Mill creek sink, in Jefferson County, Florida, about three miles southwest of Lloyd's Station, on the railway. Here it is associated with a number of other characteristic fossils of the Orthaulax bed. The fossils occur here in a sort of clay overlying a bed of limestone, and are in the form of siliceous pseudomorphs, as at Ballast Point.

Conus adversarius Conrad.

Part i. p. 26.

Specimens obtained by Mr. Willcox in North Carolina show that the obliquity of the spire varies, and though it is usually more oblique than in Conrad's figure, occasionally it is found revolving in a nearly horizontal plane as he represented it.

FAMILY PLEUROTOMIDÆ (supplementary).

Genus **DRILLIA** Gray.

Drillia tuberculata Emmons.

Pleurotoma tuberculata Emmons, Geol. N. Car., p. 265, fig. 147, 1858.

Pliocene of the Croatan and Waccamaw beds in North and South Carolina, Johnson.

This species recalls *D. leucocyma* Dall, but it is proportionately stouter. It is readily recognized by three or four stout spiral threads, without transverse sculpture, which characterize the first whorl of the shell, following the smooth nucleus of a single turn. There are seven or eight shouldered ribs on the body-whorl in front of the anal fasciole, which is finely spirally threaded, with one strong spiral between it and the suture, which is usually closely appressed.

Drillia myrmecoön n. s.

Plate 14, figure 2.

Drillia eburnea Dall, part i. p. 30, 1890, not of Conrad.

Pliocene (?) of the Cape Fear River, North Carolina, Johnson; of the Caloosahatchie beds, Florida, Dall.

Shell small, rather stout, elongate ovate or pupiform, of seven or eight whorls; nucleus blunt, smooth, large, of about one whorl followed by a whorl recticulately sculptured, the spirals smaller and uniformly closely set, the transverse sculpture of slightly larger, concavely arcuate riblets; on the body of the shell the spiral sculpture consists of rounded, strong threads, three on the periphery and one between the suture and the anal fasciole; the latter has one smaller thread behind it and two on the fasciole in front of it; on the body-whorl there are nine or ten strong spirals alternating with finer ones beside those on the pillar; transverse sculpture of (on the body-whorl nine) well-marked ribs with wider interspaces, strongest near and behind the periphery and evanescent anteriorly; aperture short, narrow; pillar short, stout; pillar lip callous, smooth; canal wide, very short, not recurved; anal notch shallow; outer lip slightly thickened, smooth inside. Lon. of shell 10; of last whorl 5.5; of aperture 3.5; max. lat. of shell 3.5 mm.

Worn and immature specimens of this species were identified by me in the first part of this paper with Conrad's *D. eburnea*—an error which the receipt of better specimens from the Cape Fear River region has enabled me to correct. The most characteristic feature of the species is the pupiform manner in which the anterior end is contracted. In good specimens the sculpture is sharp and strong.

Drillia hoplophorus n. s.

Plate 14, figure 1 a.

Pliocene of the Waccamaw beds at Tilly's Lake, S. C., Johnson; of the Caloosahatchie beds at Shell Creek, Florida, Willcox.

Shell stout, with nine whorls sharply sculptured all over except the blunt nucleus, which is worn in the specimens, but was probably smooth followed by a reticulate sculpture; on the rest of the shell the spiral sculpture is composed of stout spiral threads, of which two at the periphery and two at the suture are stronger, those on the anal fasciole close-set and smaller, those in front of it alternated with finer ones, and these again on the body-whorl often have a fine, sharp intercalary thread; on the pillar the threads are strong, but more uniform; transverse sculpture of sharp, somewhat elevated laminæ in harmony with the incremental lines, which, except on the fasciole, when perfect, somewhat reticulate the spirals and tessellate the sutural pair; there are also eleven or twelve rather sharp, narrow, short ribs, extending from the fasciole to the suture on the upper whorls, obsolete in front on the body-whorl; anal fasciole narrow, well marked with a sharply cut notch at the outer lip; suture closely appressed, on the early whorls wound just in front of the periphery, giving an overhanging look to the whorls which the later ones lose; body-whorl rounded; pillar short, recurved, covered with a smooth, continuous callus at the aperture; aperture narrow; outer lip arched, thin, simple, smooth inside. Lon. of shell 17.3; of last whorl 10.0; of aperture 6.5; max. lat. of shell 7.0 mm.

The principal features of this species, which is of the general group of *D. leucocyma* Dall, are the narrow, constricted anal fasciole, the two prominent peripheral and latticed sutural spiral threads, the irregular, strong, alternated sculpture of the body-whorl, and the general prominence of the ornamentation.

Drillia aphanitoma n. s.

Plate 14, figures 1 b, 2 b.

Pliocene of the Caloosahatchie River and Shell Creek, Florida, Dall and Willcox; also from probably Pliocene beds on the Cape Fear River, North Carolina, Johnson.

Shell with a pointed, conical spire and large body-whorl, obsolete sculpture, two smooth nuclear and eight later whorls; nucleus small, blunt, followed by a closely reticulated third whorl; spiral sculpture obscure, of larger and smaller spirals, more or less alternated, but hardly interrupting the continuity of the surface, the most evident being a peripheral pair; the whorl is thickened in front of the appressed suture, and yet not distinctly to form a thread; the spirals are most distinct near the pillar; transverse sculpture of (about nine on the body-whorl) well-marked, prominent ribs, extending on the early whorls from suture to suture, and rather wide incremental lines, sometimes pleated at the suture; anal fasciole not constricted, obscure, with a shallow notch; pillar distinct, with a well-marked siphonal fasciole; internally with a smooth enamel reflected over it; aperture narrow; canal recurved, deeply notched; outer lip thin, arched, simple, varicose behind, smooth within. Lon. of shell 21.5; of last whorl 11.3; of aperture 8.4; max. lat. of shell 8.0 mm.

Variety *oxia*. Plate 14, figure 1 b.

This differs from the type in having twelve instead of nine ribs, the sculpture sharper, showing about seven primary spirals, the much wider interspaces with six or seven microscopic, nearly equal, threads in each; and the spire shorter in proportion. It is from the beds of the Cape Fear River, collected by Mr. C. W. Johnson. More material may prove it to be distinct. The length of the specimen is 16.0 mm.

The species as a whole is marked by its obsolete sculpture, which looks as if it had once been strong, but had, while soft, been patted flat. The shape of the early whorls recalls *D. hoplophorus;* the sculpture suggests the following species, from which, however, the very much larger nucleus of *D. aphanitoma* at once distinguishes it.

Drillia schismatica n. s.

Plate 14, figure 1.

Pliocene of Shell Creek, Florida, Willcox.

Shell elongated, with a sharp-pointed spire, smooth two-whorled nucleus and nine later whorls; nucleus very small, followed by one whorl with large, very oblique, smooth transverse ribs and no spiral sculpture; later whorls with two sorts of spirals, the primaries strong, one in front of the suture, two at the periphery, one behind the suture or covered by it, and on the last whorl five or six more anteriorly; the rest of the shell, including the anal fasciole (except the canal), is covered with small, sharp, distinct, equal spiral threads, of which on the body there are four or five between the primaries; there are six secondaries on the anal fasciole and sometimes two or three between the ante-sutural primary and the suture; transverse sculpture of 11–12 well-marked riblets, with about equal interspaces, overridden by the spirals and strongest at the shoulder; anal fasciole well marked, depressed, flattish; aperture moderately wide, with a short, wide canal, well-marked siphonal fasciole and smooth, callous inner lip; anal notch rather shallow, outer lip smooth inside, simple or slightly crenulate by the primaries. Lon. of shell 20.5; of last whorl 11.0; of aperture 7.5; max. lat. of shell 7.0 mm.

This species is notable for its sharp-cut sculpture and minute nucleus, giving a very pointed aspect to the spire and separating it at once from several adjacent forms which show on the later portions of the shell a closely similar sculpture.

Drillia sigela n. s.

Plate 14, figure 2 a.

Shell Creek Pliocene, Willcox.

Shell much resembling *D. hoplophorus*, from which it is best separated by a differential diagnosis. The present species has a more slender shell, with the same number of whorls; the last whorl is proportionally shorter; the fasciole is smooth instead of spirally striate, and the margin behind it wants the double threads of *hoplophorus*, being rudely appressed and thickened without spiral sculpture. The pillar in *D. sigela* has a strong siphonal fasciole; the nucleus does not differ markedly. Lon. of shell 16.0; of last whorl 8.0; of aperture 5.3; max. lat. of shell 5.3 mm.

Though closely related, I have been unable to reconcile this shell specifically with any of the varieties of *hoplophorus* which I have examined.

Genus **GLYPHOSTOMA** Gabb.

It is probable that *Clathurella*, Carpenter, should be adopted in place of *Glyphostoma*, but many incongruous forms have been referred to *Clathurella*, and I have not been able to study Carpenter's type-species. For these reasons I do not make any change in the nomenclature here.

Glyphostoma Johnsoni n. s.

Plate 14, figure 6.

Cape Fear River Miocene beds, Johnson.

Shell with five later sculptured and probably two smooth nuclear whorls, one broken in the specimen; spiral sculpture in the later whorls strong, consisting of five rounded primary threads between the anal fasciole and the suture in front of it, the two strongest at the periphery shouldering the whorl; in front of the shoulder the primaries are alternated by secondaries except on the canal; there are about twenty primaries altogether, including those on the canal; behind the shoulder the anal fasciole is flattened and inclined to the suture like a roof; it is entirely covered with close-set, uniform secondary threads, six or eight in number; transverse sculpture of about fifteen short, mostly peripheral, riblets, the interspaces of which are prolonged forward as deeply impressed lines on the last whorl; aperture narrow, anal notch wide and deep, outer lip heavily varicose, denticulate at the edge and lirate, with prominent short denticles within; canal deep, short, recurved; inner lip callous, with five or more prominent denticles upon the enamel. Lon. of shell 10; of last whorl 7; of aperture 5; max. lat. of shell 5 mm.

This elegantly sculptured little species differs from *G. Watsoni* in its larger size and simply alternated spiral sculpture on the anterior part of the last whorl, and in minor details of the mouth-sculpture. *G. incilis* is nearly twice as large, beside having a quite different sculpture, and none of the recent species seem to approach the present species closely. It is named in honor of Mr. Chas. W. Johnson, Assistant Curator of the Museum of the Wagner Free Institute of Science, who collected it.

Daphnella elata Dall.

Plate 21, figure 1.

Daphnella elata Dall, Blake Rep. Gastr., p. 105, 1889; Trans. Wagner Inst. iii. p. 39, 1890.

As this interesting little shell has not been figured, a figure is now supplied.

FAMILY CANCELLARIIDÆ (supplementary).

Genus **CANCELLARIA** Lamarck.

Cancellaria conradiana Dall var. **rotunda**.

Part i. p. 42, pl. 3, figure 13, 1890.

Mr. Willcox has collected at Magnolia, Duplin Co., North Carolina, from the newer Miocene, some fine specimens which appear to be referable to a variety of this species which may take the name *rotunda*. They agree in all essentials with the Pliocene *C. Conradiana* and the recent *reticulata* Linné, except in relative height. In this respect they are intermediate between the two, being taller than the tallest recent specimens and shorter than the *C. Conradiana*. The largest specimen is larger than any specimen either of *reticulata* or *Conradiana* I have seen. It measures 66.25 mm. long, 35.0 mm. in maximum diameter, and exhibits nine whorls, without the nucleus.

Cancellaria (Trigonostoma) sericea n. s.

Plate 14, figures 7, 7 a.

Pliocene of Shell Creek and the Caloosahatchie, Dall and Willcox.

Shell of moderate size, strong, scalar, of six whorls, including a rather irregular, smooth nucleus of one and a half whorls; spiral sculpture of little-elevated, flattish, close-set threads consisting of primaries (about eight between the carinæ of the last whorl), separated by somewhat smaller secondaries in sets of three, alternated with very minute tertiaries toward the last, which are absent on the earlier whorls, where the number of secondaries also becomes gradually smaller; the difference between primaries and secondaries is not very marked; the transverse sculpture, apart from fine incremental lines, is confined to a few strong, irregularly placed, rounded varices, angulated somewhat at the carinæ. The type-specimen has six of these, that at the aperture being close to the next preceding, but separated by half a turn from the next earlier; whorls rounded at the sides, strongly carinated before and behind and sloping obliquely from the posterior carina to the suture, so that the latter is really anterior to the carina; umbilicus large and funicular; aperture entire, subtriangular; pillar with three sub-equal, equi-distant plaits, outer lip thickened with about ten liræ, which stop short of the margin. There are a few obscure lirations elsewhere in the aperture. Lon. of shell 16; of aperture 8.5; max. lat. of shell 11.6 mm.

This elegant little species, by its peculiar spiral, even striation, like wound silk, differs from all the other American species, recent or fossil, which have come under my notice. There is no approach to reticulation except in the earlier whorls, and very little there.

FAMILY OLIVIDÆ (supplementary).

Genus **ANCILLA** Lamarck.

Ancilla Lam., Prodr. Nouv. Class., p. 70, 1799.
Ancillaria Lam., Ann. du Mus. xvi. p. 302, 1810. Dall, part i. p. 46.

In conformity with the rules of nomenclature, the earlier form of the name must be adopted.

FAMILY MARGINELLIDÆ (supplementary).

Genus **MARGINELLA** Lamarck.

Marginella eulima n. s.

Plate 13, figure 10.

Marginella limatula Dall, part i. p. 50 (spotted variety).

Pliocene of Shell Creek (Willcox) and the Caloosahatchie beds.

Shell differing from *M. limatula* Conrad in being uniformly narrower and more cylindrical, with a spotted surface, less angulated at the shoulder, with a wider canal, a more denticulated outer lip and a nearer approach to the tip of the spire by the posterior commissure of the aperture. Lon. of shell 13.0; max. lat. 6.6 mm.

The reception of more perfect and more numerous specimens of this form from Mr. Willcox enables me to definitely separate it from the typical *limatula*. An examination of a large number of the recent *limatula* fails to show any spotted specimens. The spotting on *M. eulima* is of opaque white flakes on a translucent enamel which has sometimes turned yellowish. The only recent species which approach *M. eulima* are *M. pruinosa* Hinds, from which the former differs by its greater posterior attenuation, its less marked shoulder-angle, more flexuous outer lip, and in the presence of the thick and widespread callus on the body; and *M. nivosa* Hinds, which is more the shape of the present species, but larger, stouter, and having numerous small differences of detail. It is not unlikely, however, that *M. eulima* is the Pliocene ancestral form of *M. nivosa*.

Marginella onchidella n. s.

Plate 13, figure 7.

Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox.

Shell related to *M. rostrata* Redfield, from which it differs by its more ovate-cylindrical form, wider aperture, less angular periphery, and particularly by a peculiar lump of callus on the middle of the enamel of the body, looking as if a drop of enamel had been allowed to fall there and become partially diffused at the edges before hardening. The average specimen is considerably larger than the specimens of *rostrata* I have been able to use for comparison. A being the most perfect specimen selected for figuring, but undersized, B will indicate one of the larger ones. Lon. of shell A, 15.0; B, 19.3; max. lat. of shell A, 9.0; B, 11.5 mm.

The whole shell is thin, clean-cut and elegant.

Marginella (Volutella) dacria n. s.

Plate 14, figure 5.

Pliocene of North and South Carolina, in the Waccamaw and Croatan beds, Johnson.

Shell small, cypræiform, callous, ovate-pyriform; aperture as long as the shell, rather wide, rounded at the ends; inner lip with four plaits, larger anteriorly; outer lip denticulate on its inner edge, the denticles rather more prominent on the anterior half; base of the shell enclosed in a halo of callus, which in old specimens marginates the shell much as in such a *Cypræa* as *C. annulus*. Surface enamelled, the spire hidden, the enamel smooth and polished. Max. lon. of shell 5.0; lat. of same 3.3; alt. of back when the shell lies on its aperture 2.3 mm.

This is the largest and most characteristic of our East American species of *Volutella*, and easily distinguished by its flattened form when mature. Like all the species, it varies somewhat in size, and is more globular when the enamel has not been deposited. It was obtained by Mr. Johnson from the Waccamaw and Croatan beds, and also from the Cape Fear River marls. The measurements given are of an average specimen.

Mr. Harris, of the U. S. Geological Survey, has collected a large, very globose specimen of *Volutella* at Plum Point, Maryland, in the older Miocene. It appears to be different from any of the described species.

FAMILY VOLUTIDÆ (supplementary).

Genus SCAPHELLA Swainson.

Subgenus Scaphella s. s.

Scaphella Trenholmii Tuomey and Holmes.

Part i. p. 88; T. & H., Pl. Fos. S. C., p. 128, pl. 27, figs. 7, 8.

A fine series of this species has been obtained by Messrs. Willcox and Johnson from the Miocene of the vicinity of the Natural Well, Duplin Co., N. C.

The species is a characteristic Miocene fossil, as far as we now know. It is rather stout, its nucleus is devoid of a calcarella; the earliest whorls show only a trace of transverse ribbing, while the spiral striation is quite persistent. There are always three strong plaits beside that on the edge of the pillar. The specimens I have seen are remarkably uniform in characters.

Subgenus **Aurinia** Adams.

Scaphella (Aurinia) mutabilis Conrad.

Fine specimens of this species were obtained from the newer Miocene by Mr. Willcox from Duplin Co., North Carolina; and specimens so close to *S. dubia* as to be doubtfully distinguishable, from the older Miocene beds of St. Mary's River, Maryland.

I have become convinced that the shell figured by Tuomey and Holmes (Pl. Fos. S. Car., pl. 27, fig. 6) as a variety of *mutabilis* is really the adult form of *Aurinia obtusa* Emmons; at all events, we now have *obtusa* of various ages from the Miocene of Yorktown, Virginia, and Wilmington, Cape Fear River, North Carolina; from the Pliocene of the Waccamaw beds of South Carolina, and of Volusia Co., Florida. Whether *mutabilis* and *obtusa* must not be referred as varieties to the type-form *dubia* (which was earliest named) is a question which I do not feel able to answer. There is no doubt that in the specimens we have examined there are, on the one hand, the slender, straight, glossy *dubia* with a moderately small bulbous tip as figured (pl. 7, fig. 4) and with the canal not recurved. This grows to a large size and has sometimes a larger, sometimes a smaller, tip to the shell—as everybody who has opened the ovicapsules of such mollusks knows that, before they make their way out, the larval shells are already of markedly different sizes in the same capsule. On the other hand, we have the broad-tipped *obtusa*, with a broader body-whorl in proportion than the others and a distinctly (though slightly) recurved canal. One could get along very well with these if it were not for the obtrusive *mutabilis*, which in the same beds offers every degree of mutation between the two extremes both in regard to the curvature of canal and robustness of general habit, including the nuclear whorls. The number of plaits in all is normally two, but Mr. Willcox obtained a fragment of a very fine *dubia* at Magnolia, Duplin Co., N. C., which has three plaits and may form a variety *triplicata*. The young of the recent *dubia* shows two plaits, of *Gouldiana* three plaits, and *A. robusta* leads the list with four, which, however, in the adult are obsolete.

Scaphella (Aurinia) virginiana Conrad.

S. virginiana Conrad, part i. p. 80.
Volutifusus typus Conrad.

Older Miocene of Plum Point and the Patuxent River, Maryland, Harris and Willcox; newer Miocene of North Carolina, Conrad.

A fine series was obtained by Mr. Willcox of this puzzling form. It is smaller than *dubia* or *mutabilis*, and is, perhaps, the earliest species of this line of development which we call *Aurinia*. It has a small, bulbous nucleus like that of *dubia*, and five subsequent whorls, while *obtusa* of about the same size has only four whorls. There are two very stout, thick but not clear-cut plaits, which are not so oblique as in most of the species, the sutural margin of the whorl is constricted, and the transverse riblets on the early whorls in most specimens are rather conspicuous.

There seems little reason to doubt that this is distinct, though it verges pretty close to some varieties of the *mutabilis-obtusa* form. I have already pointed out that Conrad's first specific name must be rejected as in direct conflict with fact, and that it would be as well to adopt his MS. name of *virginiana* applied to the same species in the collection of the Academy of Natural Sciences, Philadelphia.

Subgenus **Caricella** Conrad.

Scaphella (Caricella) podagrina Dall.

Plate 20, figure 9.

C. podagrina Dall, part i. p. 86, 1890.

One of the typical specimens is now figured to illustrate the species.

FAMILY MITRIDÆ (supplementary).

Genus **PERPLICARIA** Dall.

Perplicaria perplexa Dall.

Plate 3, figure 1; plate 13, figure 4.

Perplicaria perplexa Dall, part i. pp. 90, 181, 1890.

Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox.

Much to my satisfaction, among the shells presented by Mr. Willcox to the National Museum in 1891, collected by him at Shell Creek, Florida, a mature specimen of this singular form turned up. This is a good deal smaller than the Caloosahatchie specimen would have been if perfect, but presents the characters sufficiently, and has been figured. It measures 17.5 mm. long, the aperture 9.0 mm. and the maximum diameter is 6.0 mm. The discovery of the entire shell, unfortunately, does not clear up its systematic relations. It proves to have two plaits, extremely oblique, a lirate, patulous outer lip, a canal so short, wide and straight as to be hardly recognizable as such. From the mitras of the section *Mauritia* it differs by its paucity of plaits, their obliquity, and the absence of a recurved canal. The latter is also present in *Dibaphus edentulus*. Perhaps this species may be regarded as most nearly allied to *Mitra*. It has not, so far as known, any recent analogue.

Genus **Mitra** Lamarck.

Mitra carolinensis Conrad.

Specimens of *M. carolinensis* obtained by Mr. Willcox in North Carolina are fully as large as *M. lineolata* Heilprin, from which they are hardly to be distinguished. The young of the two forms differ much more than the adults, and it cannot be doubted that the *lineolata* is the Pliocene descendant of the species in question.

Mitra Millingtoni Conrad.

Part i. p. 94.

This species was described, with most of the other forms figured in Wailes's Geological Report of Mississippi, in the Proceedings of the Academy of Natural Sciences, Philadelphia, page 261, vol. vii. for 1855.

FAMILY TURBINELLIDÆ (supplementary).

Genus **TURBINELLA** Lamarck.

Turbinella scolymoides Dall.

Part i. p. 98, pl. 3, figs. 2, 5, 1890.

A number of specimens of this species were obtained at Shell Creek by Mr. Willcox, which appear to diminish the gap between it and *T. scolymus*. It is possible that the Pliocene form may eventually rank no higher than a sub-species.

FAMILY FASCIOLARIIDÆ (supplementary).

Genus **FASCIOLARIA** Lamarck.

Fasciolaria (**Sparrowi** var.?) **acuta** Emmons.

Plate 13, figure 2.

F. Sparrowi Emmons, N. C. Geol. Surv. Rep., p. 253, fig. 115, 1858.
F. acuta Emmons, N. C. Geol. Surv. Rep., p. 254, fig. 117, 1858.
F. subtenta Conrad, Proc. Acad. Nat. Sci., 1864, p. 211; Am. Journ. Conch. vi. p. 314, pl. 13, fig. 3 (broad variety).

Miocene of Duplin Co., N. C., at the Natural Well and vicinity, Willcox; and Cape Fear River, Emmons.

Shell large, solid, eight-whorled; nucleus small, at first smooth, later transversely ribbed with small arched riblets; whorls somewhat compressed behind the periphery, suture distinct, deep on the later whorls; transverse sculpture of eight or nine wave-like peripheral ribs which are variable in strength, sometimes obsolete and absent from the terminal whorl; also of fine impressed, wavy lines, covering the whole surface and sometimes regularly spaced so as to crenulate the minuter spirals; as the shell grows old it has at the last a tendency to resting stages or varicosity of the outer lip, which in some specimens gives the effect of obscure varices or irregular, wavy, narrow ribs on the periphery of the last half of the last whorl, but these may be wholly absent; spiral sculpture of fine striæ covering the whole surface, and of strong carinated ridges more or less alternated in size on the earlier and nearly uniform on the later whorls; canal long, wide, quite tortuous, with a strong siphonal fasciole; aperture elongated; outer lip flexuous, a little reflected, compressed near the suture, receding near the periphery and produced anteriorly, internally lirate with rather distant, sharp, sometimes duplicate elevated threads; throat with an obscure subsutural ridge and at maturity a few short, strong, irregular liræ near the suture on the inner lip and on the pillar at the canal; inner lip wide, callous, smooth, except for the liræ; pillar twisted, with two deep grooves behind its elevated edge, so that there are practically three plaits, which in mature specimens are nearly hidden behind the pillar. Lon. of two specimens, A and B, A 120, B 115 mm.; max. lat., A 55, B 52 mm. Lon. of aperture and canal, A 72, B 71 mm. Another in Coll. Willcox measures 140 mm. long by 62 mm. wide.

This fine shell has been badly figured by Emmons, and it was thought well to refigure it, as it has been so little known that a broad variety of it has been described by Conrad under the new name of *subtenta*.

F. Sparrowi has been poorly described by Emmons, and it is necessary to devote some study to his description in order to understand exactly what his phrases mean. The typical *Sparrowi* differs from the broad specimens of *F. acuta* in the character of the spiral sculpture, which is sparser, not carinate, with rounded or flat-topped, rather widely separated, elevated threads, with the small intercalary thread often wanting. The aperture is flexuous, the outer lip recedes toward the periphery, and then proceeds forward nearly parallel with the axis, so that the incremental lines cross the axis obliquely behind the periphery and axially in front of it, the periphery being marked by one or more stronger spirals, behind which the whorl is flattened toward the suture. The whorls are crossed by ten or twelve rounded, rather prominent, slightly flexuous ribs, which become obsolete toward the suture, and on the last whorl are well marked only toward the periphery. The interspaces of the spirals are more or less channelled, while in *acuta* the spirals are keeled or sharp-edged, and slope evenly toward the middle of the interspaces from the keel. In *acuta* there are no well-defined ribs on the body-whorl, the shell is less flattened in front of the suture, and has a longer and more twisted canal, being, on the whole, a longer and more slender shell, with more crowded sculpture and less regular ribbing. These differences are, however, all of degree and not of kind, and a sufficient amount of material might show the extremes to be connected by intermediate specimens, as with the varieties of *F. gigantea*. Specimens of *Sparrowi* corresponding to the above description have been found at Alum Bluff, on the Chattahoochee River, Fla. (Burns), at Faison, Duplin Co., N. C. (Willcox), and at Purdy's marl-bed, Bladen Co., N. C. Most of the specimens from the vicinity of the Natural Well, Duplin Co., are unmistakable *F. acuta*, though often quite as wide as the typical *Sparrowi*.

The same beds afforded specimens of *F. gigantea*, not apparently separable from recent specimens by any important or even fairly discernible characters. It seems quite probable that to a young, nodulous and imperfect specimen of this species the shell figured by Emmons as *F. nodulosa* is to be referred. Neither figure nor description is sufficiently distinctive, and the types having been burned in the State Capitol, during the late war, there can be no appeal to them for enlightenment. There was already a *F. nodulosa* of Defrance. *F. alternata* Emmons was perhaps a *Latirus*. It must be relinquished as neither sufficiently described nor anywhere figured.

Fasciolaria elegans Emmons.

Plate 13, figure 9.

Fasciolaria elegans Emmons, Geol. N. Car. Rep., p. 252, fig. 114, 1858.
F. (*Terebraspira*) *elegans* Conr., Proc. Acad. Nat. Sci. Phila., 1862, p. 561; Miocene Checkl. Inv. Foss., Smiths. Inst., p. 21, 1864.

Miocene of Duplin Co., N. C., Emmons and Willcox; Pliocene of the Waccamaw River (worn fragments), Johnson.

Shell strong, elongate (decollate), with more than eight whorls; apex (lost, probably three or four whorls)? earliest remaining whorl (diam. 5 mm.) as well as the next one with eight rounded ribs, behind which it is constricted, crossed by about six raised spiral threads; general outline of whorls flattened from the periphery toward the suture, rounded in front, attenuated toward the canal; suture distinct, deep; transverse sculpture except on the earlier turns, consisting only of rather strong incremental lines; spiral sculpture of obscure microscopic striations and occasional grooves, and (between the sutures six) on the last whorl about thirteen strong, elevated spiral ribs with narrower deep channelled interspaces with a few minor threads on the siphonal fasciole; canal short, recurved; aperture elongate, narrow behind and before; outer lip slightly flexuous, sharp-edged, thin, crenulated by the sculpture; internal liræ numerous, close-set, not all equally long; on the body a sharp subsutural lamina and a group of rather irregular, short, sharp, elevated lines, a few irregular, elongated granulations in front of the ends of the plaits on the pillar at the beginning of the canal; inner lip callous, mostly smooth; siphonal fasciole strong. Lon. of decollate shell 122, of aperture and canal 66, of last whorl 87, max. lat. of last whorl 54 mm.

This splendid species was very inadequately figured by Emmons, for which reason a new figure of Mr. Willcox's specimen is given. The plaits are like those of *F. acuta*, and in the adult are visible only from the side; but the difference in this respect from other species is so slight that it seems unnecessary to propose, as Conrad has done, a new sub-generic name for it. The prominence of the plaits on the pillar is dependent on the stage of growth, and they are less conspicuous in fully adult shells throughout the genus than in those not perfectly mature. The fragments from the Pliocene were so worn as to waken a suspicion that they had been derived from an antecedent bed and did not really form a part of that fauna. They were more distinctly and strongly transversely ribbed than the one figured.

Of the other species which have been referred to, this genus from the Neocene of the United States, excluding those previously referred to, *F. parvula* Lea, is probably a small *Mitra* similar to *M. wandoensis* T. and H.; while *F. Tuomeyi* Holmes may very probably belong to another genus altogether.

Genus **GLYPTOSTYLA** Dall.

Shell thick, pyriform, reticulately sculptured, with a narrow produced canal; outer lip expanded and thickened internally; pillar with two strong plaits connected by a grooved callus; body callous, but with no subsutural lamina; nucleus minute, prominent; spire short; suture distinct but not channelled.

Type *G. panamensis* Dall. Tertiary of the Isthmus of Darien, near Panama.

This form is extremely puzzling. It recalls *Pyrula* and other Tænioglossa by its external characters, *Turbinella* and *Mazzalina* by its solidity and heavy outer lip, *Latirus* and *Volutilithes* by its plaits. A species which, in all probability, should be referred to this genus is *Turbinella crassitesta* Gabb (Geol. Surv. Cala. Paleont., vol. ii. p. 157, pl. 26, fig. 36, Dec., 1868), from the Martinez Group of California. The canal in this form is straighter than in the type, but the other features are so similar that I cannot hesitate to include the Californian fossil with that from Panama.

The Martinez group, being transitional in its character, has been merged in the Chico-Téjon series, which covers the continuous upper Cretaceous and lower Eocene of that section. It is impracticable at present to assign a positive place in the geological scale to the Californian form, except as above indicated.

The Panama specimens come from the line of the canal in a cut 19 kilometers southward from Colon (or Aspinwall, as it is sometimes called), at a few feet above sea-level. The station where the cut was made was known as Vamos-vamos, and the specimens, consisting of several masses of clayey and sandy, rather soft, dark-gray rock, were kindly submitted to me for examination by Prof. Alex. Agassiz.

With the *Glyptostyla* were associated numerous specimens of *Turritella Gatunensis* Conrad, a species resembling *T. arenicola* from the upper Eocene of Arkansas, a *Cerithiopsis*, *Neverita* (like small *duplicata*), *Natica* (sub-genus *Cochlis*, close to *maroccana*) and a *Cadulus;* with these were the following Pelecypods: *Arca* (near *transversa*), *Leda* (hardly distinguishable from *L. acuta* Conr.), *Cytherea*, *Semele*, *Mactra* (like *alata*, but small and sub-triangular), *Corbula*, and *Strigilla*. This assemblage has not a very ancient appearance and can hardly be older than the Eocene, while containing nothing which might not be of Miocene age.

Glyptostyla panamensis n. s.

Plate 13, figure 5.

From the Miocene (?) of the isthmus, on the line of the Panama Canal, at Vamos-vamos station, 19 kilometers from Colon.

Shell pyriform, solid, thick, with about six whorls; nucleus small, prominent, marked with revolving striæ; shell covered with a closely reticulated sculpture consisting of transverse and spiral ridges of about equal strength and equidistant; the transverse ridges in the earlier whorls are relatively sparser and stronger, crenulating the suture, while on the later whorls the spiral ridges override the others and are slightly more prominent; the interspaces are channelled and the spirals strap-like; the transverse ridges are less regular in shape; the spire is low, slightly compressed in front of the distinct suture, with the latter marginated by the two adjacent spirals, which tend to be larger than the others; last whorl inflated, attenuated in front, slightly expanded behind and laterally at the aperture; canal produced, narrow, a little recurved; outer lip simple, smooth, marginated internally by a broad callous deposit, narrower behind and at the canal, and not lirate; body callous, smooth, with no subsutural lamina; pillar callous, curved, with two very strong, rather posterior rounded plaits, with the interspace between them and probably the part of the pillar adjacent to the plaits spirally grooved. Lon. of shell 30; of aperture and canal 26; max. lat. of shell 20 mm.

It differs from *G. crassitesta* Gabb in its closer reticulation, more prominent spire and more curved canal, if, indeed, the canal of Gabb's species is not rather too straight in his figure.

Genus **MAZZALINA** Conrad.

Mazzalina Oweni Dall.

Part I., p. 105, 1890.

Specimens obtained by Mr. G. D. Harris, of the U. S. Geological Survey, from various localities in Arkansas, lead to a doubt whether this form is really distinct from *Fusus inauratus* Conrad. At all events, the specimens in which the labial plaits are absent, and which in other respects do not seem to differ from typical *M. Oweni*, bear a striking resemblance to Conrad's shell.

Genus **MELONGENA** Schumacher.

Melongena subcoronata Heilprin.

Part I., p. 120, 1890.

Since the above reference was printed, Mr. Willcox has been devoting especial attention to collecting specimens of *Melongena*, and has now brought together a magnificent series at the Wagner Institute. The result of an examination of this material is to raise a serious doubt as to the value of the distinctions noted between this form and its undoubted descendant, *M. coronata*. It seems highly probable that the two are not more than subspecifically separated.

Genus **SOLENOSTEIRA** Dall.

Solenosteira inornata Dall.

Plate 20, figure 17.

Part I., p. 123, 1890.

Older Miocene of the Tampa limestone, banks of the Hillsboro' River, near Tampa, Florida, Dall.

A figure illustrating this species is given as derived from a restoration for which several gutta-percha casts served as a basis.

Genus **FUSUS** Lamarck.

Fusus equalis Emmons.

Plate 14, figure 3 b.

Part I., p. 126, 1890.

The reference to Alum Bluff should be erased. The specimens obtained from Alum Bluff were referable to *Fusus exilis* Conrad, and the reference was due to an accidental substitution of one name for the other in the manuscript.

A typical specimen of *F. equalis* is figured from the Duplin Natural Well, N. Carolina, for comparison with the following related species :

Fusus caloosaensis Heilprin.

Plate 14, figures 3, 4 a.

Part I., p. 127, 1890.

This species was not figured in Part I. of this report through an accident by which the figure was unavailable. A new figure has been made from a typical specimen from the Caloosahatchie Pliocene, and another illustrating the short variety, *carolinensis*, from the Pliocene of the Waccamaw beds at Tilly's Lake, South Carolina, collected by Mr. C. W. Johnson.

These extremes are connected by intermediate specimens and illustrate a peculiarity which has several times attracted the writer's attention—namely, that in a long (North and South) meridional geographical series, both in recent and fossil species of this group on the Atlantic coast of the United States, the northern specimens tend to vary in the direction of a short and stout form, and the southern ones in the opposite direction.

This is doubtless due to something in the environment—food, temperature or other factor as yet unknown—but the fact is worthy of attention.

Fusus quinquespinus Dall.

Plate 20, figure 8.

Part I., p. 128, 1890.

No better material having come to hand, the best of the Ballast Point pseudomorphs has been figured to illustrate this puzzling form.

FAMILY BUCCINIDÆ (supplementary).

Genus PISANIA.

Subgenus Celatoconus Conrad.

Celatoconus Conrad (n. g.), Cat. Mioc. Shells, Proc. Acad. Nat. Sci., Dec., 1862, p. 566. (No diagnosis or figure.) Meek, Checklist Inv. Foss. Miocene, p. 17, No. 570, 1864.
Caelatoconus Conrad, Am. Jour. Conch. iii. p. 267, 1868. (No diagnosis.)

Type Celatoconus protractus Conrad.

Buccinum protractum Conr., Proc. Acad. Nat. Sci. Phila. i. p. 308, Oct., 1843. (Calvert Cliffs, Md. Unfigured.)
Celatoconus protractus Conrad and Meek, *op. cit. supra.*
Caelatoconus protractus Conr., Am. Jour. Conch. iii. p. 267, pl. 20, fig. 6, 1868.

The genus *Celatoconus* was never described by Conrad, who listed it as a genus in the family *Conidæ*, and a quarter of a century later published a figure of the type specimen, which is a fragment comprising the last whorl of a shell without the spire. This fragment is 33 mm. long. An examination of it satisfied me that it belonged to a shell closely related to *Pisania*, and the reception of specimens of another species of the same group from North Carolina enables me to constitute the group. It is hardly more distinct from *Pisania* proper than is *Tritonidea*, and in some respects is intermediate between them. *Celatoconus*, like *Metula*, differs from all the Pisanias in wanting the subsutural callus and contracted notch of the posterior commissure of the aperture; in its thinner shell, larger nucleus, and thin and smooth callus on the body and pillar. All the other characters of the shell may be observed in *Pisania* or *Tritonidea*. The type belongs to the Chesapeake Miocene of Maryland.

This group differs from *Lævibuccinum* (*prorsum* Conr.) by being somewhat stouter, with a less flexuous outer lip, and in having cancellated instead of only spiral striation. Both are separated from *Pisania* proper chiefly by the absence of the subsutural callus. This can hardly be regarded as of generic significance. From the point of view of descent it looks as if *Lævibuccinum* led the way, was succeeded by *Celatoconus*, which in turn gave way to *Pisania* proper. The relations of *Metula* with *Celatoconus* stand in need of investigation.

Pisania (Celatoconus) nux n. s.

Plate 13, figure 6.

Miocene of the Cape Fear River, Johnson; one fragment from Mrs. Guion's marl-bed, another from Purdy's; also at Natural Well, Duplin Co., Burns.

Shell small, not heavy, subfusiform, with a rather short, pointed spire and about seven whorls; nucleus of two and a quarter smooth whorls, apex moderately pointed, whorls rapidly enlarging beyond it; spiral sculpture of about five revolving, strap-like elevated bands on the earlier whorls, with wider interspaces, especially that next the suture; later whorls show an intercalary fine thread in each interspace; the spirals pass over more obscure transverse riblets, of about their own width, which ripple them, and on the last whorl and a half give rise to squarish little-elevated nodules at the intersections; the incremental lines are distinct, and the sculpture is practically uniform over the whole shell; most of the shell is comprised in the last whorl, and the aperture is longer than half the shell; outer lip gently arched, and in the adult somewhat varicose behind the margin; suture very distinct, not channelled; aperture rather narrow, canal short and wide; outer lip simple, with a row of denticles within behind the edge, but no liræ in the throat; body with a thin, smooth callus; pillar short, obliquely truncate, with an obscure anterior plait and siphonal fasciole. Lon. of shell 18; of aperture 11; max. lat. of shell 9 mm.

A number of specimens have been examined which appear fairly uniform in size and character. It is smaller and more globose than the typical species, of which only one last whorl, wanting the spire, is known. This is in the collection of the Academy of Sciences, Philadelphia.

Genus **PTYCHOSALPINX** Gill.

In 1826 (Hist. Nat. Eu. Merid., Moll., p. 172), Risso had named a genus *Tritia* for a compound of *Planaxis*, *Anachis*, and various species of *Nassa*, which he abandoned in favor of *Planaxis* Lamarck, though his *Tritia* included more than *Planaxis* proper. Later, H. and A. Adams (Gen. Rec. Moll. i. p. 122) revived the name *Tritia* for Nassas with elevated whorls, reticulated thin shells, with moderate callus and a simple, non-varicose outer lip. They included in it such forms as *N. reticulata* L., *N. trivittata* Say, and *cancellata* Chemn. Conrad (Proc. Acad. Nat. Sci., 1862, p. 562) adopted the name, which he used to cover the majority of American Miocene *Nassidæ*, except the smooth forms, which he referred to *Bulliopsis* Conrad as a subgenus, though this is perhaps more nearly related to *Cominella*.

In 1866 Stimpson (Am. Journ. Conch. i. p. 61) proposed a new genus of *Nassidæ*, *Ilyanassa*, based on *N. obsoleta* Say. A feature not emphasized by Stimpson, and perhaps correlated with the absence of the caudal cirri, is the short, hardly recurved canal and the consequently feeble siphonal fasciole, hardly separated from the base of the body-whorl on account of the absence of the constriction which is so characteristic of the true Nassas.

In 1867 (Am. Journ. Conch. iii. p. 153) Gill separated as a genus of *Buccinidæ* under the name of *Ptychosalpinx* a species which had been described by Conrad as *Buccinum altile*, and subsequently referred by him to *Tritia*. The following year Conrad (*op. cit.*, p. 261) discussed *Ptychosalpinx*, which he referred to the *Nassidæ* and discriminated two groups: 1, those related to *P. altilis*, and 2, those typified by *P. porcina*, which have a slightly thickened, internally lirate outer lip. The latter group he denominated *Paranassa*, at the same time recognizing *Ilyanassa* and *Ptychosalpinx* as genera, and referring *Paranassa* to the latter as a subgenus. He also describes a subgenus *Tritiaria* for *Nassa trivittata* Conr. *non* Say, which he renames *T. peralta.*

In 1889, the writer (Rep. Blake Gastr., p. 175) described a recent species, which with little doubt is properly referable to *Ptychosalpinx* proper, having all the conchological characters of that group, and showed that by the features of the anatomy the animal, as supposed by Gill, is really related closely to *Chrysodomus* of the *Buccinidæ*, and therefore should be separated from the nassoid forms heretofore associated with it.

The following species appear to be correctly referable to *Ptychosalpinx* as restricted:

Ptychosalpinx (*Buccinum*) *altilis* Conr. sp. (1832) Gill, Am. Journal Conch. iii. p. 154, 1867.

Chesapeake Miocene of Maryland and Virginia.

Ptychosalpinx (*Buccinum*) *multirugata* Conr. sp. (1841), Am. Journ. Sci. xli. p. 345; Gill, *op. cit.*, p. 154.

Chesapeake Miocene of Maryland at Easton.

Ptychosalpinx (*Buccinum*) *fossulata* Conr. sp. (1843), Proc. Acad. Nat. Sci. i. p. 308.

This species appears to be a smooth form of Conrad's *B. bilix* as originally described, but that name includes in later references two species, one of which may prove to be a *Rapana.* As neither has been figured, it will probably be best to drop the name *bilix* entirely, the original and only description being quite insufficient to determine the species. It has been collected by Mr. G. D. Harris, of the U. S. Geol. Survey, at Plum Point, Maryland, and near Yorktown, Va., in the Chesapeake formation. Conrad's type in the Academy's collection can hardly be separated from the preceding species.

Ptychosalpinx (*Buccinum*) *Tuomeyi* H. C. Lea sp. (1845), Trans. Am. Phil. Soc. ix. p. 271, pl. 37, fig. 97.

This species, according to specimens obtained by Mr. Harris at Yorktown, Va., is less flattened at the sides than Lea's figure would indicate, and is more buccinoid in general appearance than any of the others. It is only known from the Chesapeake Miocene of the James River, Va.

Ptychosalpinx (*Buccinum*) *laqueata* Conr. sp. (1832), Foss. Tert. Form., p. 19, pl. 4, fig. 5.

Chesapeake Miocene of James River, Virginia, and Alum Bluff, Chattahoochee River, Florida.

This species by its sharp-cut sculpture and axial plications recalls *Phos* and such species as "*Nassa*" *unicincta* Say, which the writer has already shown (Blake Gastr., p. 178) has a nearly buccinoid operculum.

Ptychosalpinx (*Buccinum*) *lienosum* Conrad (Proc. Acad. Nat. Sci. i. 308, 1843), though a mere fragment, hardly appears to differ from *P. fossulata.* It has been figured in the Am. Journ. Conch. iii., pl. 19, fig. 9.

FAMILY NASSIDÆ (supplementary).

The other species enumerated by the various authors referred to will find a proper place in the *Nassidæ*, and may be apportioned among the following groups: *Ilyanassa* and its section *Paranassa;* and *Nassa* proper, section *Alectrion* Montfort.

Genus **ILYANASSA** Stimpson.

Subgenus **Paranassa** Conrad.

Ilyanassa (Paranassa) porcina Say.

Buccinum porcinum Say, Journ. Acad. Nat. Sci. iv. p. 126, pl. 7, fig. 3, 1824; Emmons, N. C. Geol. Surv., p. 256, fig. 122, 1858; Tuomey and Holmes, Pleioc. Foss. S. Car., p. 133, pl. 28, fig. 1, 1856.
Tritia porcina (Say) Conrad, Proc. Acad. Nat. Sci. Phila., 1862, p. 562.
Ptychosalpinx porcina Gill, Am. Journ. Conch. iii. p. 154, 1867.
Paranassa porcina Conrad, Am. Journ. Conch. iii. p. 262, 1868.

Chesapeake Miocene of Maryland, Virginia and the Carolinas.

This species has rounded whorls, a rather acute, rapidly dwindling spire, appressed sutures and feeble siphonal fasciole; when well grown it has a thickened outer and inner lip and a single or double subsutural ridge. It is of rude, rather irregular growth, and is almost destitute of basal constriction behind the fasciole.

Ilyanassa (porcina var.?) schizopyga Dall.

Shell differing from typical *porcina* by its more elevated and conical spire, its less inflated last whorl, square or rounded but not appressed suture, constricted base, strong, flaring, sub-umbilicate siphonal fasciole, and more uniform and sharply reticulate sculpture. The aperture is thickened on both sides, there is no subsutural lamina and the liræ of the outer lip run deeply into the aperture instead of being confined to the vicinity of the margin. Alt. of shell 32; max. diam. 18 mm.

This apparently distinct form was found in Mrs. Purdy's marl-bed on the Cape Fear River by Mr. C. W. Johnson. It is probably later Miocene. I hesitate to assign it an absolute specific rank, notwithstanding the characters mentioned, in the absence of more profuse material; that available being only two rather worn specimens.

Ilyanassa (Paranassa) arata Say.

Plate 20, figure 15.

Buccinum aratum Say, Journ. Acad. Nat. Sci. iv. p. 127, pl. 7, fig. 4 (bad), 1824.
Tritia arata Conr., Proc. Acad. Nat. Sci., 1862, p. 562.
Paranassa arata Conr., Am. Journ. Conch. iii. p. 262, 1867.
Tritia idonea Conr., MS. label in coll. Acad. Nat. Sci.

Chesapeake Miocene of Maryland (Say), North Carolina (Burns), and Pliocene of the Waccamaw beds in South Carolina, C. W. Johnson.

This species is shorter and more inflated, but with a more acute spire than the following form:

Ilyanassa (Paranassa) isogramma n. s.

Plate 20, figure 16.

Chesapeake Miocene of James River, Va., near Bellefield, Harris; and of the Cape Fear River, near the Carolina Central R. R. station at Wilmingtan, North Carolina, Clark; Pliocene of the Waccamaw beds, South Carolina, Johnson; and at De Leon Springs, Florida, Wright. The last locality is a little doubtful in age, but probably belongs to the Pliocene, at least in part.

Shell elevated, moderately heavy, with about seven moderately rounded whorls, a distinct suture and even, uniform spiral threading, crossed only by fine lines of growth; the interspaces are usually narrower than the threads and are sometimes mere grooves, the threads are occasionally feeble; body whorl not greatly inflated, the base not constricted, the fasciole obscure and the canal extremely short; the outer lip slightly thickened, internally lirate, with about eight short liræ; lon. of shell 24; max. diam. 14 mm.

This form appears to be distinguished from *I. arata* by its closer and finer spiral sculpture, more elevated spire, less inflated last whorl, and generally by a somewhat pupiform outline.

Subgenus **Ilyanassa** s. s.

Ilyanassa irrorata Conrad.

Buccinum obsoletum Tuomey and Holmes, Pleioc. Foss. S. C., p. 135, pl. 28, fig. 5, 1856. Not of Say.
Tritia irrorata Conr., Proc. Acad. Nat Sci. Phila. for 1862, p. 562.
Ilyanassa irrorata Conr., Am. Journ. Conch. iii. p. 263, pl. 19, fig. 10, 1867.

Pliocene of the Waccamaw beds, South Carolina, Holmes and Johnson.

This species seems sufficiently distinguished from its descendant, the *I. obsoleta*, by its much stronger sculpture, larger size and heavier, distinctly granulated shell. It is, however, closely related to it.

Ilyanassa granifera Conrad.

Ilyanassa (Paranassa) granifera Conrad, Am. Journ. Conch. iii. p. 263, pl. 19, fig. 6, 1867.

Chesapeake Miocene of Yorktown, Va., Harris; and of the Natural Well, Duplin Co., North Carolina, Burns.

This species is well distinguished from the preceding by its rather uniform rounded, close-set riblets and the sharp, undulated spiral ridges which cross them.

It does not belong to the group of *Paranassa*, but to *Ilyanassa* as restricted. It is almost always a distinctly smaller and less elevated shell than *I. irrorata.*

Ilyanassa granifera var. **sexdentata** Con.

Buccinum sexdentatum Conr., Proc. Acad. Nat. Sci. i. p. 308, 1843.
Tritia sexdentata Conr., Proc. Acad. Nat. Sci. 1862, p. 562.
Paranassa sexdentata Conr., Am. Journ. Conch. iii. p. 262.

Chesapeake Miocene of North Carolina, at the Natural Well, Duplin Co., Willcox and Burns; Wilmington, Burns; Mrs. Purdy's and Mrs. Guion's marl-beds, Cape Fear River, C. W. Johnson.

This form differs from the typical *granifera* in fineness and closeness of its spiral threads much as *Nassa consensa* Rav. differs from *N. antillarum.* If constant these characters would entitle it to specific rank, but as I find occasional specimens with alternate coarse and fine lines, I conclude it is merely a variety of *I. granifera.* As the latter is the most abundant and evidently the normal form, and has been figured, I retain the specific name, rather than the present one, for the type.

Genus NASSA Lamarck.

Section *Alectrion* Montfort.

These fossils differ from those referred to *Ilyanassa* by their sharply constricted base, strong siphonal fasciole and obviously nassoid characters, etc., recalling many of the exotic recent species. Mr. Conrad's specimens in several instances were immature or did not possess the normal reflected lip and labial callus, for which reasons he was mistakenly led to refer them to *Ptychosalpinx* or *Paranassa.*

Nassa harpuloides Conrad.

Buccinum harpuloides Conr., Proc. Acad. Nat. Sci. for 1843, p. 326, 1844.
Paranassa harpuloides Conr., Am. Journ. Conch. iii. p. 264, pl. 19, fig. 7, 1867.
Tritia harpuloides Conr., Proc. Acad. Nat. Sci. 1862, p. 562.
Tritia scalaris Conr., Proc. Acad. Nat. Sci. Phila. for 1862, p. 286; not *Nassa scalaris* Borson, 1825, nor *N. scalaris* A. Adams, 1851.

Chesapeake Miocene of Virginia in the vicinity of Yorktown, Conrad, Harris and Darton; of the Cape Fear River, North Carolina, at Mrs. Purdy's and Mrs. Guion's marl-pits, C. W. Johnson.

This fine species is readily recognized, even when in poor condition, by its square-sided whorls, elevated spire, and the fact that the fine spiral striation above the shoulder of the whorls is laid obliquely to the suture and not parallel to it, without reference to the undulations caused by passing over the ribs. When mature it has a heavy labial callus, subsutural ridge, thickened lirate and somewhat reflected outer lip.

Nassa scalaspira Conrad.

Ptychosalpinx scalaspira Conr., Am. Journ. Conch iii. p. 263, pl. 19, fig. 4, 1867.

Chesapeake Miocene of Virginia and of North Carolina, at the Natural Well, Duplin Co., and various places on the Cape Fear River.

This is distinguished from the preceding form by its shorter and more acute spire, its inflated last whorl, and by the fact that the spiral sculpture on the last whorl or two, next the suture, runs parallel with it, except as it is undulated by the ends of the ribs.

Nassa Johnsoni n. s.

Plate 13, figure 12.

Cape Fear River, North Carolina, Johnson, from the marl-bed at Mrs. Purdy's; and also from the Natural Well, Duplin Co., Burns.

Shell short, inflated, with a pointed but little-elevated spire and about seven whorls; nucleus lost in the types; early whorls with six or seven narrow, strap-like, revolving elevated lines, of which two are more prominent; later the prominent lines take on a more carinated appearance, and are reinforced by numerous smaller ones; on the last whorl this pre-eminence is obsolete and the spiral sculpture recalls that of *N. consensa*, consisting of very numerous continuous, even, narrow threads alternating in the proportion of one slightly more prominent followed by three to five finer and then another slightly larger one, the interspaces being equal to or slightly wider than the threads; transverse sculpture of numerous (on the last whorl 18 to 20) rounded ribs extending from the suture to the siphonal carina, with the interspaces equal or wider on the last and narrower on the early whorls; suture distinct, not channelled, toward the last laid over an edge of body callus; whorls rounded, aperture longer than the rest of the shell, wide, semi-lunar, narrow and pointed behind, with an obtuse subsutural callus; body with a broad, thick, smooth callus; pillar concave, with a prominent anterior keel, shorter than the outer lip; siphonal notch deep, with the usual nassoid keel; outer lip little reflected, moderately thickened, simple, with about fifteen short denticular liræ just within; throat without liræ. Lon. of shell 22; of aperture 13.5; max. lat. of shell 15.5 mm.

This fine species is related to "*Ptychosalpinx*" *scalaspira* and "*Paranassa*" *harpuloides* Conrad.

N. scalaspira was described from a broken specimen, but is destitute of the fine sharp spiral sculpture and has fewer ribs and a higher, more scalar spire than *N. Johnsoni.* The proportions of *N. harpuloides* are quite different, especially about the aperture, while the pillar is quite unlike that of *N. Johnsoni.*

The species is named in honor of Mr. Chas. W. Johnson, to whose successful researches we owe much valuable information as to the Tertiaries of the Carolinas.

It may be added that *Tritia* (*Buccinum*) *prærupta* Conrad appears to be synonymous with *Nassa impressa* H. C. Lea, and that the latter, which is a young and imperfect specimen, has much the aspect of a youthful *N. bidentata* Emmons.

FAMILY COLUMBELLIDÆ (supplementary).

Genus COLUMBELLA Lamarck.

Subgenus Anachis Adams.

Collumbella (Anachis) styliola n. s.

Plate 13, figure 11.

Miocene marl of the Cape Fear River, at Mrs. Guion's, Johnson.

Shell slender, acute, of eight or ten whorls; nucleus large, bulbous, smooth, of two whorls; subsequent whorls flattened, sloping, with a strong peripheral keel with a wide groove below it, on the anterior edge of which the suture runs, and a narrower groove above it; transverse sculpture of straight, strong, equal riblets with equal interspaces which extend from the suture to the keel, which is made wavy by their ends; these become more and more numerous as the whorls advance, but near the aperture become obsolete on the middle of the whorl; spiral sculpture of sharp grooves, more evident on the later whorls, one or two near the suture stronger than the others; on the middle of the whorl the spirals are more or less obsolete, but on the base and pillar of the last whorl they are broad and clear-cut, separating narrower, rounded threads; aperture narrow, with an obscure varix behind the outer lip at maturity; canal short, narrow, recurved; inner lip callous, reflected, its edge prominent, with a row of short liræ running across its inner surface; body with a thin wash of callus; outer lip sharp-edged, with a few (5-6) short liræ within, a smooth interval next the suture. Max. lon. of shell 16.5; max. diam. 5.0 mm.

This shell most nearly resembles *A. camax* Dall, which has coarser and stronger spiral sculpture, flatter whorls with a less conspicuous, more closely appressed suture and a much smaller nucleus. In *A. camax* the earlier whorls are slightly turriculate, being somewhat smaller than the sutural margin in front of them. In *A. styliola* the peripheral keel is expanded in a roof-like manner over the whorl in front of it in the earlier whorls; the pillar also is stouter and more swollen than in *A. camax*, which also has less conspicuous liration in the aperture.

FAMILY MURICIDÆ (supplementary).

Genus MUREX Linné.

Subgenus ? Pteropurpura Jousseaume, em.

Pteronotus Swainson, Part i. p. 142, 1890.

In his British Oligocene and Eocene Mollusca (1891), Mr. R. B. Newton, on the ground of preoccupation, rejects Swainson's name *Pteronotus* (which, by the way, appeared in 1835 as *Pterynotus*) and adopts for this group the name of *Triplex* (Humphrey) Perry. This is an easy if inaccurate way of deciding a question beset with no little difficulty. As a matter of fact Humphrey's name was never illustrated or defined by him. It is like *Triplex* Perry, really a synonym of *Chicoreus* Montfort (1810), and neither in its contents nor in Perry's diagnosis has any partcular application to the group designated *Pteronotus* by Swainson, though it is possible that one out of the ten species Perry illustrates may belong to *Pteronotus.* On the other hand, a swarm of names simultaneously proposed by Jousseaume (1880) are available if, as is doubtless the case, we have to give up *Pteronotus;* to say nothing of several others proposed by Bayle (1884). Among these it is difficult to know which to select. It is probable that, for the American species, *Pteropurpura,* originally founded on *Murex macropterus* Deshayes, is the most applicable, as they are most nearly related to one another and less likely to be closely allied to the Indopacific forms. The extension of *Pteropurpura* over the whole of the subgeneric group *Pteronotus* is a question requiring more attention than the writer can at present give it, to be adequately discussed.

If the recurvation of the tip of the varices be regarded as a character worthy of sectional separation, as has been claimed by Bayle, an opinion the writer is hardly ready to accept, the species *M. textilis* Gabb will be referable to the section *Triremis* Bayle. For the present it is probable that it will do very well under the designation of *Murex* (*Pteropurpura*) *textilis.*

Genus **TROPHON** Montfort.

Subgenus **Aspella** Mörch.

Aspella (Mörch) Dall, Rep. Blake Gastr., p. 206, 1889.
Poweria Monterosato *non* Bonaparte.

Trophon (Aspella) engonatus n. s.

Plate 13, figure 6 a.

Pliocene beds of Florida at Shell Creek, Willcox.

Shell elevated, with prominent sculpture and eight whorls; nucleus small, smooth, of two and a quarter whorls; remaining whorls each with three principal and three minor varices, which are thin, sharp and spinose at the intersection of the spiral ribs, especially at the shoulder; whole surface covered with a thin limy coat, evenly and finely spirally striate, but this coating is usually partly worn off, being very perishable; other spiral sculpture of three (on the last whorl 6) sharp, narrow, elevated spiral riblets which overrun the varices, and (especially on the major varices) tend to form spines at the intersection; the spiral rib at the shoulder is especially prominent and tends to turriculate the whorls; whorls full, rounded under the sculpture; aperture ovate; canal long, open, narrow, much recurved; outer lip with a few coarse liræ within in the adult. Alt. 28; max. diam. 12 mm.

This species closely resembles, when adult, the recent *Aspella obeliscus* A. Adams, but differs from it by the narrowness and sharpness of the varices and spirals, and by the spinous projections at the shoulder. The internal liræ of the outer lip are fewer and coarser than in *A. obeliscus* and the varices are not continuous up the spire with such unvarying precision in the fossil as in the recent shell. *T. engonatus* is with little doubt the Pliocene ancestor of the recent *obeliscus*. The specimen figured is not quite adult, but shows the sculpture better than an older specimen. The limy coat characteristic of the group is so easily detached that few of the shells have more than small patches of it remaining.

Genus **RAPANA** Schumacher.

Rapana tampaensis Dall var. ?

Plate 20, figure 14.

Part I. p. 153, 1890.

No additional material certainly belonging to this species has been received, but a shell which in some aspects appears almost identical with the Tampa fossils was collected by Mr. G. D. Harris, of the U. S. Geol. Survey, near Church Hill, Queen Anne Co., Md.

A specimen apparently of the same species is one of two seemingly distinct forms in the collection of the Academy of Natural Sciences at Philadelphia, labelled *Neptunea bilix* Conrad. This fossil was described by Conrad under the name of *Buccinum bilix* in 1843 (Proc. Ac. Nat. Sci. i. p. 308), and subsequently (*op. cit.* for 1862, p. 562) referred to the *Nassidæ* under the name of *Tritia bilix*. That one of the two specimens above referred to which agrees with the characters of most of Conrad's other Tritias is probably a *Ptychosalpinx*, and may preferably be allowed to retain his specific name, since his description is too brief to identify the genus or species by, and it would seem never to have been figured. The other, of which a figure is given herewith, appears to be a *Rapana*, with somewhat the form of *Chrysodomus*. The few specimens obtained appear extremely variable; some of them show rounded whorls and a channelled suture; others like the one figured have a coarse rib near the suture, and no well-defined channel. All differ from the types of *tampaensis* in having a comparatively insignificant umbilical chink and slender anterior extremity. But the variations of the *Purpuridæ* within a single species are well known to be extreme, and, until a perfect specimen of the Floridian fossil comes to hand, I am disposed to refer both to a single species in spite of the differences above mentioned.

FAMILY SCALIDÆ (supplementary).

Genus **SCALA** Humphrey.

Subgenus **Opalia** Adams.

Section *Pliciscala* De Boury.

Scala (Opalia) De-Bouryi Dall.

Plate 20, figure 13.

Part i. p. 158, 1890.

A figure of this fine species is now provided.

Subgenus **Sthenorytis** Conrad.

Scala (**Sthenorytis**) **Stearnsii** Dall.

Plate 21, figure 4.

Pliocene of San Diego, California, Dr. R. E. C. Stearns.

Shell large, stout, short conical, of about six whorls (the specimen having lost its apex, the exact number is doubtful); each whorl provided with about seven strong reflected varices, slightly angulated near the suture, where each varix is appressed against the interspace and corresponding varix of the antecedent whorl, forming a wave in the varical contour; varices very thick, sharp-edged, somewhat rugose from the prominence of the incremental lines, on the base overlapping one another, and on the spire continuous over the whorls to the apex; surface smooth, except for lines of growth; a faint indication of a basal cingulum is perceptible in one or two of the intervarical spaces; suture filled by the appressed varices; whorls very round, aperture nearly circular, except for the sutural wave. Lon. (of decollate shell 2½ whorls) 26; max. lat. 25 mm.

It was thought best in treating of the Pliocene fauna to introduce here this magnificent species, of which a single specimen was collected by Dr. R. E. C. Stearns from the Pliocene sands of Pacific Beach, near San Diego, California. It indicates the extension of the genus already known from the Miocene of Maryland and Santo Domingo, to the Pacific Coast, in a fauna where several remarkable *Scalidæ* (*Opalia anomala* and *varicostata* Stearns) are already known.

The figure given has the upper outer part of the peristome somewhat restored, and gives, perhaps, a somewhat too rounded aspect to the varix reflection; and the wave in the same, where it is appressed between the varices of the antecedent whorl, is more pronounced than seems to be normal, though in this respect it represents the fossil fairly well, but the preceding varices are more gently waved.

FAMILY EULIMIDÆ (supplementary).

Genus **NISO** Risso.

Niso lineata Conrad.

Plate 20, figure 4.

Bonellia lineata Conrad, Journ. Acad. Nat. Sci. Phila. viii. p. 188, 1842.

Actæon simplex H. C. Lea, Trans. Am. Phil. Soc., 2d ser. ix. p. 32, pl. 36, fig. 62, 1845; *fide* Conrad.

Niso lineata Conr. Proc. Acad. Nat. Sci. for 1862, p. 566; Am. Journ. Conch. ii. p. 69, pl. 4, fig. 13, 1866 (bad!).

Chesapeake Miocene of Calvert Cliffs, Maryland, Conrad; and Cape Fear River, North Carolina, at Mrs. Guion's marl-bed, C. W. Johnson.

Shell differing from *N. interrupta* in being less slender, especially toward the tip of the spire, in the more distinct suture and convex whorls, and from the young *N. Willcoxii* and *splendidula* in exhibiting beside the usual peripheral and umbilical keels several raised lines (one to three) behind the periphery and (one or two) on the base of the last whorl, beside having the entire surface obscurely spirally striate with semi-obsolete microscopic striæ; the basal keel is more rounded than in any other American species, recent or fossil, and the aperture shows hardly any angle corresponding to the peripheral keel. The largest specimen has (without the lost nucleus) eleven whorls, with a total length of 12 and diameter of 5 mm.

The characters by which this shell is distinguished from others of the genus are not so feeble as would seem at first sight, when the remarkable uniformity of the species is taken into consideration. There are no well-marked remains of color-pattern, but narrow flammules alternately opaque and more translucent, which are visible on very close examination, may correspond to a vanished color-pattern.

The figure given by Conrad in the Am. Journal of Conchology is so very poor that until the specimen was compared with Conrad's type no doubt existed in my mind that Mr. Johnson's fossil belonged to a different species.

The figure prepared of it before this impression was dispelled may aid in preventing some other student who cannot visit the Philadelphia collection from being led into a similar error. Lea's figure is fairly good, and as Conrad's diagnosis was insufficient to recognize the species by in the absence of his type-specimen, it is probable that his name should be rejected in favor of that given by Lea.

FAMILY PYRAMIDELLIDÆ.

Genus **PYRAMIDELLA** Lamarck.

The type of this genus is the *P. dolabrata*, from which it follows that *Obeliscus* is an absolute synonym, and if the genus be divided, as has been done by Gray and Adams, the short-ribbed forms for which they kept the name *Pyramidella* cannot retain it.

This group, according to Zittel, is known from the Cretaceous, but, so far as the writer is aware, the earliest American species yet recorded is from the Claiborne sands, and this, though fairly typical when adult, is when young so like an *Odontostomia* that it has been referred to that genus by De Gregorio in his recent monograph of the Claiborne fauna. It is probable he did not possess a mature example of the species, which was briefly described by Say and Morton in Conrad's name on page 46 of Part IV. of his " Fossils of the Tertiary Formation " with the designation of *P. larvata*. It was never figured by Conrad, but two months or less after the appearance of the leaflet above mentioned it was described and recognizably figured by Mr. Lea in his Contributions to Geology, under the name of *Actæon elevatus*, and a minute tip of the same species was named by Lea *A. pygmæus*. As Conrad's (or Say and Morton's) diagnosis was insufficient by itself to identify the species, it seems just that Lea's name should be retained. In the remarkable similarity of the young to the genus *Odontostomia* the derivation of the group is perhaps indicated, as *Odontostomia* is found in considerably older beds. The *Actæon magnoplicatus* H. C. Lea (Sill. Journ. 1841), which has been doubtfully referred to this species as a synonym, appears from the type in the Philadelphia Academy's collection to be really a broken *Odontostomia.* Among other Eocene forms which have been referred by Conrad to *Pyramidella* or *Obeliscus*, *O. melanellus* (Lea sp.) Conr. is an *Actæon; O. perexilis* Conr. is a *Syrnola; O. striatus* (Lea sp.) Conr. is probably an *Odontostomia:* the type is a fragment which cannot be certainly identified; *P. terebellata* (Conr. *non* Sby. = *Pasithea umbilicata* Lea) is a *Niso.* The American Tertiary forms all belong to the section *Longchæus* of Mörch.

Of Miocene American species referred to this group, *Pyramidella reticulata* Emmons, and *O. elaborata* H. C. Lea, are small mitras. *O. canaliculata* Gabb, from the Miocene of Santo Domingo, has not been figured. The supposed types at Philadelphia comprise three or four species belonging to several distinct genera, all loose in one tray together. Besides these, *O. candida* Mörch is known from the Post-Pliocene of Texas, as well as the recent fauna.

Pyramidella arenosa Conrad.

P. arenosa Conrad, Proc. Acad. Nat. Sci. Phila. i. p. 309, Nov., 1843 (unfigured). Emmons, Geol. Rep. N. Car., p. 268, fig. 154, 1858.

P. suturalis H. C. Lea, Trans. Am. Phil. Soc. ix. p. 258, pl. 36, fig. 63, 1845.

Miocene of the James River, at Petersburg, Va., and of the Purdy and Guion marl-pits, Cape Fear River of North Carolina; Pliocene of the Croatan beds, North Carolina; of the Caloosahatchie and Shell Creek beds in Florida.

This species is distinguished by having both sides of the sutural channel minutely crenulated from the next species, which has only the anterior edge crenulated. This is a very dubious and probably invalid character, by no means constant in recent specimens, and I have little doubt that the following species should be regarded merely as a variety of the present form. In all other respects they are identical and vary through a similar series of mutations in any one stratum.

Pyramidella crenulata Holmes.

Pyramidella (*Obeliscus*) *arenosa* Tuomey and Holmes, Pleioc. Fos. S. C., p. 126, pl. xxvi. fig. 17, 1857.

Obeliscus crenulatus Holmes, Post-Pleioc. Fos. S. C., p. 88, pl. xviii., figs. 14, 14 a, 1859.

Pyramidella alveata Conr., Am. Jour. Sci., 2d Ser. ii. p. 398, 1846 (name only).

Obeliscus floridanus Mörch, Mal. Blatt. 1875, p. 158.

Pyramidella tessellata Arango, Mal. Cubana, p. 161, 1880, *non* Adams.

Pyramidella crenulata Dall, Blake Gastr., p. 331, 1889.

Pyramidella (*Obeliscus*) *suprapulchra* De Gregorio, p. 158, pl. 15, fig. 30, 1890.

In the upper Pliocene of the Myakka River, Florida, Willcox; Post-Pliocene of South Carolina, Holmes; and of Florida at North Creek, Dall; living on the southeastern coast of the United States between high-water mark and two fathoms, on grassy or muddy flats, from Cape Hatteras south to Florida and in the Antilles as far as St. Thomas.

This species was first observed by Conrad at Tampa Bay, but in the account of his explorations there it is named but not described. It has been found as far west as Galveston, Texas. As previously noted, it is hardly more than a variety of the preceding.

De Gregorio in his monograph of the Claiborne fauna describes a specimen and gives a tolerable figure, but states that its provenance was unknown. It is obviously the present species.

Genus **OSCILLA** A. Adams.

Oscilla biseriata (Gabb sp.) Dall.

Triptychus niveus Mörch, Malak. Blätt. xxii. p. 159, 1875.
Cerithium biseriatum Gabb, Journ. Acad. Nat. Sci. Phila., 2d ser. viii p. 361, pl. 46, figs. 50, 50 a, 1874.
Pyramidella? vincta Dall, Proc. U. S. Nat. Mus. vi. p. 330, pl. x., fig. 7, 1885.
Oscilla nivea Dall, Rep. Blake Gastr., p. 339, 1889; Bull U.S. Nat. Mus. No. 37, p. 130, No. 625, pl. 48, fig. 2, 1889.

Found in the Pliocene clays of Costa Rica (Gabb) and in the Caloosahatchie beds (Dall); living in the Antillean region from South Florida to Martinique (Hemphill and Mörch).

This remarkable little shell has not been reported from the Pliocene deposits north of Florida, a fact which is quite as likely to be due to its small size and inconspicuous character as to a southerly limited distribution.

Genus **ODONTOSTOMIA** Jeffreys.

Odostomia Fleming, 1818, not Fleming, 1813.
Odontostomia Jeffreys, Mal. Conch. Mag. ii. p. 30, 1839.
Not *Odontostomia* Agassiz, Nom. Scudder, 1882, as of Orbigny.

This genus has been in a good deal of confusion, and I have not seen anywhere a reference to the first use of the name, *Odostomia*, by which it is most commonly known.

Sir David Brewster edited a publication called the Edinburgh Encyclopedia, of which volume vii., part one, was published in 1813, and contained an article with the caption "Conchology," by Rev. Dr. John Fleming (pp. 55–82). This very excellent naturalist afterward prepared similar articles for the Encyclopedia Britannica, fourth, fifth and sixth editions, the last of which, somewhat revised, was reprinted in 1837 as a separate volume. The Edinburgh Encyclopedia was completed up to volume xii. in 1817, and appears to have been in octavo; a subsequent edition in quarto was completed in 1830. I have not been able to consult the original edition, but have carefully searched the references of Leach (Mollusca of Great Britain) and in this way have arrived at the following facts:

In 1813 Fleming referred the following species to his genus *Odostomia: Balea perversa* (p. 76), *Clausilia laminata* (p. 76), *Clausilia biplicata* (p. 77), *Clausilia nivosa* (*O. nigricans*, p. 76), *Pupa secale* (*O juniperi*, p. 76), *Pupa umbilicata* (*O. muscorum*, p. 76) and *Carychium minimum* (*O. carychium*, p. 76).

In the same article the marine forms of late known as *Odostomia*, *O. unidentata* Mont., *O. plicata* Mont., *O. decussata* Walker, *O. pallida* Mont., *O. nivosa* Mont. and *O. truncatula* Jeffreys (as *Turbo subtruncatus* Fleming, p. 76), are all (*op. cit.*, pp. 72–76) referred to the genus *Turbo* Linné, together with species of *Rissoa*, *Phasianella*, *Aclis*, *Eulima*, *Lacuna* and *Turbonilla*, as was then customary.

It is obvious, therefore, that originally *Odostomia* was proposed for small land shells with toothed apertures, and in this sense it was adopted by Say (Nicholson's Encyclopedia, Am. edition, 1817), who referred to it what we now call *Pupa corticaria*, and by Bowdich (Elements of Conch. i. p. 30, 1822), who referred two elongated species of *Pupa* to *Odostomia* and classified it as a land shell.

According to Gray, who printed Leach's British Mollusca in 1857, the first 116 pages of that work were in type at the time of the author's death in 1820. His dedication of Part I. of the work to Savigny is dated 1815. At that time it does not appear that any marine species were included in the genus *Odostomia* by Fleming, so far as Leach's synonymic references aid us. In the edition which was completed in 1830, however (but of which vol. vii. long preceded that date), Jeffreys states (Brit. Conch. iv. p. 109) that the marine species are included.

It is probable that after Fleming had added the dentate marine forms to his dentate land species, he became aware that the latter belonged to genera established by Draparnaud and others before the publication of his own name *Odostomia*, and after referring them to their proper genera he continued to use the name for the marine residuum. In 1822 (Phil. Zool.) he refers to the Odostomias as "marine *Turbonidæ*," and in his British Animals (1828) and the reprinted supplement to the Encyclopedia Britannica (1837) only marine species, belonging to the genus as lately understood, are included.

But the faulty construction of the name had given rise to much criticism, and in 1829, Dr. Turton proposed (En. of Shells Found on the Devonshire Coast) to modify it to *Odontostoma*.* However, this was merely correcting a name which was in itself essentially a synonym, and hence unavailable for use at all. In 1839 (Mar. Moll. Argyleshire, Mal. and Conch. Mag. No. 2, p. 30), Jeffreys proposes the genus *Odontostomia* for *Turbo plicatus* Montagu. As Cossmann has pointed out, this is by derivation a distinct word from *Odontostoma* or *Odontostomus*, and hence not liable to rejection on the ground of previous ineffective use. Cossmann (Catal. Ill. Coq. Fos. Eoc. Paris, iii. p. 104, 1888) refers this name of Jeffreys to 1837, and says that Jeffreys speaks of it as intentionally a diminutive. I have not found any reference to it earlier than the one above cited, where Jeffreys indulges in no remarks whatever, and I should be glad of more light on this point. In his résumé in the British Conchology (iv. p. 108) on the history of the name *Odostomia*, Jeffreys makes no reference to his own name, *Odontostomia*, and evidently knows nothing of the early edition or publication of the Edinburgh Encyclopedia. The exact facts, however, had been noted and only too briefly referred to by Searles Wood in the first part of his Crag Mollusca (p. 85, 1848), where he alludes to the Edinburgh Encyclopedia as published in 1817, an error due to the insertion of a common title-page in earlier volumes, or possibly to citing a second edition, since we know that twelve volumes of the first edition had been issued by 1817, and the article by Fleming was in volume vii.

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* The writer has not been able to learn anything of this paper except Jeffreys' citation. It is not in his bibliography or under Turton in the Royal Soc. Cat.

A name, *Dontostoma*, has been attributed to Klein, who was not a binomial writer and is not entitled to be cited in systematic nomenclature. Of the other names of this general formation, *Odontostomus* Beck dates from 1837, and the same word was used for a fish in 1838 by Cocco. *Odontostoma* Orbigny (not *Odontostomia*, as Agassiz has it in Scudder's Nomenclator) was published in 1842 (and not 1839 as per Agassiz). The others are emendations by Agassiz which are all of later date and not recognized by modern rules of nomenclature.

While admitting that the last word has not been said on the subject, owing to the fact that part of the literature is inaccessible to him, the writer concludes that *Odostomia* Fleming (1813) is a synonym of *Pupa*, *Clausilia*, etc., and that the name in that form is ruled out by this ineffective use of it. There is no evidence accessible in regard to *Odontostoma* Turton. The next name in order appears to be *Odontostomia* Jeffreys, which for present purposes may be adopted subject to revision on receipt of further information.

Odontostomia conoidea Brocchi.

Turbo conoideus Brocchi, Conch. Foss. Subapp. ii. p. 659, pl. xvi. fig. 2, 1814.
Odostomia conoidea Jeffreys, Brit. Conch. iv. p. 127, v. p. 211, pl. lxxiii. fig. 6, 1869.
Odostomia acutidens Dall, Proc. U. S. Nat. Mus. vi. p. 331, 1883.

Fossil in the Miocene, Pliocene and Pleistocene of Europe and living on the coasts of Europe and the Mediterranean from Hammerfest to Gibraltar and the Grecian Archipelago, according to Jeffreys; in America fossil in the older Miocene marls of Shiloh, New Jersey, the newer Miocene at Mrs. Guion's, Cape Fear River, North Carolina, the Pliocene of the Caloosahatchie (var. *acutidens* Dall) and the Post-Pliocene of North Creek, Little Sarasota Bay, Florida; living from Cape Hatteras to Florida and on the Gulf coasts, Jewett, Hemphill, etc.

The Norwegian recent specimens are absolutely indistinguishable from the Shiloh fossil. The var. *acutidens* is the southern, especially Floridian, form both recent and fossil, it is less elevated, slightly more angulate toward the base, and has a proportionately more prominent and sharp-edged tooth or plait on the pillar. There is a fine series of the typical *conoideus* in the Jeffreys collection with which the American specimens have been carefully compared.

Odontostomia impressa Say.

Turritella impressa Say, Journ. Acad. Nat. Sci. ii. p. 244, 1822.
Chemnitzia impressa Stimpson, Sh. of N. E., p. 42, 1851.
Odostomia impressa Gould, Inv. Mass., Ed. Binney, p. 330, fig. 600, 1870.

Pliocene of the Caloosahatchie beds and Shell Creek, Florida; Post-Pliocene of South Carolina; living from Massachusetts Bay to St. Augustine, and in the northern part of the Gulf of Mexico.

This is one of those species which seem to have reached the shores of the Gulf of Mexico in the early Pliocene, before the Georgian Strait was closed, but which never doubled the southern end of the peninsula.

Odontostomia seminuda Adams.

Jaminia seminuda Adams, Bost. Journ. Nat. Hist. ii. p. 280, pl. 4, fig. 13, 1839.
Odostomia seminuda Gould, Inv. Mass., p. 273, fig. 178, 1841; Dall, Bull. U. S. Nat. Mus. No. 37, p. 130, No. 638, pl. 52, fig. 10, 1889.
O. var. *granatina* Dall, Proc. U. S. Nat. Mus. vi. p. 331, 1883.

Fossil in the newer Miocene at Mrs. Guion's and Mrs. Purdy's marl-pits on the Cape Fear River, North Carolina; in the Pliocene of the Croatan beds in North and the Waccamaw beds in South Carolina, the Caloosahatchie beds and Shell Creek in Florida; living from Prince Edward's Island (Hinkley) to Florida and the Gulf of Mexico.

This species has a somewhat similar distribution to the preceding, but is known to have penetrated as far south as Charlotte Harbor. It is the *O. granulatus* of Holmes (as of H. C. Lea), but probably not of Lea.

Subgenus **Syrnola** A. Adams.

Odontostomia (Syrnola) fusca C. B. Adams.

Pyramis fusca Adams, Bost. Journ. Nat. Hist. ii. p. 282, pl. 4, fig. 9, 1839.
Jaminia fusca Adams, *op. cit.*, iii. p. 337, 1840.
Odostomia fusca Gould, Inv. Mass., p. 270, fig. 342, 1841.
Chemnitzia fusca Stimpson, Sh. of N. Engl., p. 41, 1852.
Syrnola fusca Dall, Bull. U. S. Nat. Mus. No. 37, p. 130, No. 628, pl. 52, fig. 15, 1889.

Fossil in the Pliocene of the Caloosahatchie beds and the Post-Pliocene of North Creek, Little Sarasota Bay, Florida; living from Cape Cod southward to Florida, but extremely rare everywhere.

Odontostomia (Syrnola) caloosaënsis n. s.

Plate 15, figure 12 b.

Newer Miocene of the Cape Fear River at the Guion and Purdy marl-beds (?); Pliocene of the Caloosahatchie; Post-Pliocene of North Creek, Little Sarasota Bay, Florida, Willcox; living in 16 fathoms sand off Cape Fear, North Carolina, and southward to East and West Florida, in grassy weed between tides; thence to the Bahamas (Brown) and Samana Bay, Santo Domingo, Couthouy.

Shell small, white or pale brownish with a paler peripheral band when living, with an immersed small sinistral nucleus and six subsequent whorls; apex rather pointed, sides of the spire slightly flattened; suture very distinct; last whorl a little constricted, its suture tending to coil below rather than at the periphery of the antecedent whorl; aperture entire, pointed behind, the anterior portion a little produced; plait lagging behind the pillar in the adult, more conspicuous in younger shells; a chink exists behind the lip, but the shell is not umbilicated. Lon. of shell 3 4; max. lat. 1.0 mm.

This species has been in the writer's possession for a number of years, represented by recent specimens. It appears to be rather rare in the fossil state. In the adult, looking perpendicularly to the plane of the aperture into the mouth, the plait on the pillar is invisible, as represented in our figure. It may be seen from the side and is fairly obvious in the young. It differs from the next species by its more inflated, pupoid form, smooth surface and larger size. In both the sinistral nucleus is buried in the tip of the spire and invisible.

Some imperfect specimens from the Cape Fear River obtained by Mr. Johnson resemble this species, but are more inflated, with only four and a half or five whorls and a much less acute spire. These are hardly perfect enough to apply a name to, but seem too distinct to be regarded merely as a globose variety of *S. caloosaensis*.

Odontostomia (Syrnola) attenuata n. s.

Plate 13, figure 8.

Pliocene marl of the Cape Fear River, North Carolina (Johnson); living in 430 fathoms, coral mud, off the Rebecca shoals, East Florida, Dr. Rush.

Shell resembling the preceding, with the same number of whorls (when living of a waxen white), but more cylindrical, with the sutures more appressed, the last whorl less constricted, the plait on the pillar stronger and more evident, and the general form more slender. The surface is marked with obsolete spiral lines not everywhere apparent; it is probable that the adult has the peristome continuous, but the specimens examined are not completely mature. Lon. 3.3; max. lat. 0.7 mm.

The living specimen is slightly more robust than the fossil, and therefore has the sutures somewhat more evident, but otherwise agrees exactly with it.

Genus **TURBONILLA** Risso.

Subgenus **Ondina** De Folin.

Ondina De Folin, Les Fonds de la Mer, i. p. 214, 1869; name only; ex. *O. sulcata* De Folin.

Ondina De Folin, Classif. coq. fam. *Chemnitzidæ*, Ann. Soc. Lin. de Maine-et-Loire, xii. 1870 (extra copies p. 10).

Ib. Const. meth. fam. *Chemnitzidæ*, Soc. Agr. Hist. nat. et Arts utiles de Lyon, 1885, p. 15.

Auriculina Gray, 1847, *non* Grateloup, 1838.

Shell of the form of *Odontostomia*, but with a somewhat twisted pillar without a plait, like that of *Turbonilla* s. s. The surface is spirally striated and the throat not lirate.

The first mention of the name was in 1869, when it was used as above cited in the text, without a diagnosis, for the *O. sulcata*, which, however, is named *Odetta sulcata* on the plate and agrees with the diagnosis of the section *Odetta* as simultaneously proposed by De Folin in the paper on the classification of *Chemnitzidæ*. It appears that *O. sulcata* must have been referred to *Ondina* by an inadvertence, and since the plate was drawn by the author himself, that his application of the name *Odetta* must be regarded as correct.

In the diagnosis of the "family Chemnitzidæ" no types or species are mentioned, and the "genus *Ondina*" remained without any specific exemplar until 1872, when an *Ondina semi-ornata* was described by De Folin from the Gulf of Gascony, which agrees with his diagnosis and must be regarded as the type of the group (Les Fonds de la Mer, ii. p. 48, pl. ii. fig. 1, 1872). Regarding the *Auriculina* of Gray, founded on *Od. obliqua* Alder, as synonymous with *Ondina*, Dr. Fischer in his manual (p. 788) gives *O. obliqua* as an example. He refers the group to *Odostomia* as a section, but it is, perhaps, preferable to regard it as bearing to *Turbonilla* proper such a relation as *Odontostomia* bears to *Syrnola*.

Turbonilla (Ondina) fragilis n. s.

Plate 20, figure 5.

Pliocene of the Waccamaw River, South Carolina, Johnson.

Shell small, thin, with an acute spire, a sinistral, half-immersed nucleus and five and a half subsequent whorls; surface polished, the summit smooth, the whorls gradually becoming finely, evenly spirally striate; whorls full, yet slightly flattened toward the periphery, giving them a turriculate appearance; base ovately rounded, with a minute chink behind the reflected pillar-lip; outer lip thin, pillar slightly thickened, the lips united across the body by a thin deposit of callus, anterior edge of the aperture evenly rounded into the pillar, which is slightly twisted; throat smooth; suture very well marked, but not channelled. Lon. 4.75; max. lat. 2.25 mm.

This is a very neat little shell which, so far, has not turned up in the Caloosahatchie beds.

Subgenus **Turbonilla** s. s.

The genus *Turbonilla* was founded by Risso (using a manuscript name of Leach) on three fossil species, two of which according to his figures were polished, transversely ribbed, with no tooth on the pillar and with no spiral sculpture. The third was similar, but had a fairly distinct plait on the pillar. In his supplement he added a *T. Humboldti*, a recent species which appears to be an *Odontostomia*. The synonymy of the group, which has been excessively subdivided, is so profuse and complicated that the writer will not attempt on this occasion to apportion it. The endeavor to identify the fossil specimens and compare them with an extremely large series of recent forms, comprising about a thousand individuals from the American coast and four or five times as many from the coasts of Europe, has convinced the writer that these small shells are extremely variable in several characters which have often been relied on for separating them, even into subgenera as well as species, and that the group cannot properly be divided on the basis of the tooth or plait on the pillar or its absence. The transition from a straight pillar to one slightly twisted, and from a slight twist to a stronger one, becoming in sturdy individuals a well-marked plait, is extremely gradual and sometimes traceable in individuals of the same species. Doubtless there are species which always have the pillar straight and devoid of a plait. But there are others, so closely related to them as to be hardly distinguishable, which have a faint plait, or none, indifferently; and occasional individuals of these have a strong plait. The plait is frequently invisible from the aperture, but sharp and strong in the whorls half way up the spire, where by cutting away the wall of the whorl it may be seen. The attempt to transfer all the plaited species to *Odontostomia* has been a failure, and many of them will have to re-enter this genus when better known. For the present it will be more prudent to group both toothed and simple species under the subgenus as restricted. The following scheme will be convenient for assorting the species:

A. Shell without spiral sculpture (*Turbonilla* s. s.).
  a. Ribs ceasing abruptly at the periphery ;
    *a** pillar straight, simple ;
    a† pillar twisted or plaited.
  b. Ribs becoming gradually obsolete on the base ;
    *b** pillar straight, simple ;
    b† pillar twisted or plaited.
B. Shell sculptured axially and spirally.
  a. Ribs ceasing abruptly at the periphery ;
    *a** pillar straight, simple ;
    a† pillar twisted or plaited.
  b. Ribs gradually obsolescent ;
    *b** pillar simple ;
    b† pillar twisted or plaited.
C. Shell sculptured spirally or smooth.
    *c** pillar simple ;
    c† pillar twisted.

Transitions will be found between these different groups whenever a sufficiently large series is examined.

The angle at which the sinistral tip is inclined is not absolutely constant, even in the same species, but in general is nearly at right angles to the axis of the adult shell. The larval whorls, so far as yet observed, are always smooth; the ribs are usually more pronounced toward the apex, if not uniform; but the spiral sculpture, if variable, tends to be stronger on the later whorls; from which we may surmise that the ancestors of the group were smooth, that the axial ribs were subsequently acquired, while the spiral grooving is, on the whole, a still later development.

Pasithea lugubris Lea, *P. secale* Lea, and *P. elegans* Lea, from the Clabornian, are probably referable to this genus.

Turbonilla virgata Dall.

T. exarata Holmes, Post-Pl. Foss. S. Car., p. 82, pl. xiii. figs. 2, 2 a, 2 b, 1859; as of H. C. Lea, 1845.

Not *Pasithea exarata* Lea, Trans. Am. Phil. Soc. ix., extras p. 25, pl. 35, fig. 44, 1845.

Later Miocene of North Carolina at Mrs. Purdy's marl-bed on the Cape Fear River, Johnson; Pliocene of the Caloosahatchie beds and the Myakka River, Florida, Dall and Willcox; living from North Carolina to Florida in 12 to 80 fathoms, U. S. Fish Commission and other collectors.

This species resembles *T. nivea* Stm., but has more numerous, slender and oblique ribs, which cease at the periphery. The pillar is straight, especially in the young, and none of the specimens show any plait. It does not appear to be identical with Lea's species from the Virginia Miocene, to which it was referred by Holmes. Some fragments from the Waccamaw beds may be referable to this species.

Turbonilla nivea Stimpson.

Chemnitzia nivea Stm., Proc. Bost. Soc. Nat. Hist. iv. p. 114, 1851; Shells of N. E., p. 40, 1851.

Turbonilla nivea Stm., S. I. Checklist of Sh., 1865; Binney's Gould, p. 331, 1870 (figure 602 excluded); Holmes, Post-Pl. Foss. S. C., p. 83, pl. xiii. figs. 3, 3 a, 3 b, 1859.

Pliocene of the Waccamaw beds, N. Carolina, Johnson; Post-Pliocene of John's Island, Cainhoy and Simmons's Bluff, South Carolina, Holmes; living from Eastport, Maine, to the Carolinas.

The figure given by Binney does not represent this species and does not agree with Stimpson's types in the National Museum. Holmes's specimens were partly identified by Dr. Stimpson, and his figure agrees with authentic specimens. The species has been distributed by the late Col. E. Jewett, under the erroneous name of "*T. gracilis* De Kōnig."

A few worn fragments from Tilly's Lake appear to be referable to this species. They do not show any plait on the pillar.

Turbonilla exilis C. B. Adams.

Chemnitzia exilis C. B. Adams, Contr. to Conch., p. 74, 1850.
Turbonilla exilis Dall, Bull. U. S. Nat. Mus. No. 37, p. 128, No. 594, 1889.

Pliocene of the Caloosahatchie beds and Shell Creek, Florida, Dall and Willcox; living from Cape Hatteras, N. Car., to Haiti in from 3 to 63 fathoms.

The species resembles *C. levis* Ads., but is smaller. In some specimens there is a feeble ridge on the pillar.

Turbonilla stricta Verrill.

T. stricta Verrill, Rep. Invert. An. Vineyard Sd., p. 365, 1874.

Pliocene of the Waccamaw beds, S. Car., Johnson; living from Wood's Holl, Mass., to Long Island Sound, and probably still farther down the coast; a fragment dredged off Cape Hatteras is probably conspecific.

Specimens of Verrill's form agree with the fossils fairly well. It must be remembered, in considering the distribution of the living forms, that our Southern coast is but very imperfectly explored for these minute species, and most of the forms originally described from the New England coast have since been found in the Carolinas.

The specimens examined show that the ribbing tends to become obsolete on the last whorls of the adult, and that an extremely feeble ridge is sometimes visible on the pillar.

The preceding species are devoid of spiral sculpture, but in those that follow it exists more or less distinctly.

Turbonilla puncta C. B. Adams, var., **obsoleta** Dall.

Chemnitzia puncta C. B. Ads., Contr. Conch., p. 72, 1850.
Turbonilla puncta Dall, U. S. Nat. Mus. Bull. 37, p. 128, No. 593.

Pliocene of the Caloosahatchie, Dall; living from Cape Hatteras to Haiti in 12 to 15 fathoms.

The figure of this species given by Mr. Tryon in his Manual I have compared with Prof. Adams's type-specimen, and find it inaccurate, as it is too conical and does not show the punctures sufficiently well.

The fossil differs from the recent shell in the feebleness of the spiral sculpture, and especially in the fact that the ribs are not cut off abruptly at the periphery, but diminish somewhat gradually into the smooth base of the last whorl, so that the foveolate character of the interspaces is lost. But as I have only one specimen, and have observed that in some of the recent forms the character alluded to is not invariably constant, I have preferred to separate the form varietally rather than specifically until I can examine more material.

The pillar appears to be simple.

Turbonilla textilis Kurtz.

Chemnitzia textilis Kurtz, Cat. Rec. Mar. Shells N. and S. Car., p. 8, 1860.

Pliocene of the Caloosahatchie beds, Dall; living at Charleston, S. Car. (Kurtz), and Marco, Florida (Hemphill).

This species was identified from specimens sent by Kurtz to Stimpson and preserved in the National Museum. The original description would not suffice to discriminate the species from allied forms. The base is sharply defined in young shells, and the early whorls have prominent ribbing very close set, so as to almost hide the spiral striation. In older specimens the ribbing is feebler and more distant on the later whorls and not abruptly cut off at the periphery, while the spirals are more evident. It is closely allied to *T. multicostata* Ads., which, however, attains a larger size and has less prominent and more uniform ribbing, with the whorls slightly marginated near the suture. The pillar seems to be simple in all the specimens.

Turbonilla virga Dall.

T. (*viridaria var.?*) *virga* Dall, Proc. U. S. Nat. Mus. vi. p. 332, Dec., 1883.
T. virga Dall, Rep. Blake Gastr., p. 336, 1889.

Pliocene of the Caloosahatchie, and living from Hatteras to Key West in 2 to 15 fathoms.

The base of this slender, small species is well defined; the faint interstitial spiral sculpture is often hardly visible on account of the closeness of the ribbing. The pillar is simple, but slightly twisted.

Turbonilla pupoides Orbigny.

Chemnitzia pupoides Orb., Moll. Cuba, i. p. 224, pl. xvi. figs. 32, 36, 1841.
Chemnitzia latior C. B. Ads., Contr. Conch., p. 72, 1850.
? *Turbonilla subcoronata* Holmes, Post.-Pl. Foss. S. Car., p. 87, pl. 13, figs. 12a-b, 1859.

Pliocene of the Caloosahatchie beds; living at Jamaica, St. Thomas and on the shores of Cuba.

The fossil agrees exactly with Adams's type-specimens, which differ from Orbigny's figure only in exhibiting a slight constriction in front of the suture, which makes the ends of the ribs coronate the whorl. But Orbigny's specimen was young and his figures are very formal, and the species are doubtless synonymous. The pillar is straight and simple.

Orbigny's names all antedate those of Adams, and several of Adams's species are doubtless synonymous, but in the absence of authentic specimens it is impossible to identify them. The figures of Orbigny in most cases are pretentious, but obviously inaccurate. Having made careful comparison with Prof. Adams's types in the Amherst Cabinet, and possessing in the National Museum a number of specimens named by Adams himself, his names can be identified with much more accuracy, while his descriptions are more full, careful and accurate than those of the Mollusques de Cuba. The student who in the future devotes himself to the study of this minute, populous and perplexing group, and who can compare specimens with the types of Orbigny in European museums, will doubtless find many rectifications of nomenclature to make which at present are impracticable.

Turbonilla speira Ravenel ?

Chemnitzia speira Rav., Proc. Elliott Soc. Nat. Hist. i. p. 280, 1859.
Turbonilla speira Holmes, Post-Pl. Foss. S. Car., p. 82, pl. xiii. figs. 1, 1 a, 1859.

Pliocene of the Caloosahatchie beds? Post-Pliocene of South Carolina.

I had for some time supposed that Ravenel's species was a somewhat abnormal specimen of *T. interrupta.* But among the fragments found in the Caloosahatchie marl is a broken *Turbonilla* which presents characters resembling those illustrated in Holmes's figure, and which is probably different from any variety of *interrupta.* The principal characters are the few but rather strong, wave-like ribs not interrupted at the base, the sharp, well-defined spiral sculpture covering the shell, and a prominent spiral a little in front of the suture which gives an obscure shoulder to the whorl. As far as I have been able to learn, no authentic specimens of Ravenel's species exist anywhere, and our whole dependence must be placed on Holmes's figure of it. The fragment referred to may perhaps be identified with it. The pillar is distinctly twisted and the whole shell is more conical than most of the species.

Turbonilla chipolana n. s.

Older Miocene of the Chipola beds, Burns.

Shell small, slender, with a smooth nucleus and nine to sixteen subsequent sculptured whorls; sculpture of fifteen to twenty smooth, nearly straight, close-set ribs extending from the suture forward to and becoming obsolete on the base; spiral sculpture of six or more fine, incised lines nearly equidistant between the suture and the periphery, visible only between the ribs, a few others faintly visible on the base; sides of the spire rectilinear, suture distinct, applied a little in front of the periphery; aperture rounded in front, pointed behind, with a distinct though very small, thread-like plait coiled on the middle of the pillar. Lon. (of a specimen of ten whorls) 4.25; max. diam. 1.0 mm.

This species grows longer than the dimensions given, but of the larger ones I have only seen fragments.

This species is very close to *T. virga* Dall, but has the spiral grooving less conspicuous, while *T. virga* has not the raised thread on the pillar. In *T. virga* the sides of the spire have a less rectilinear habit.

I refer provisionally to this species a fragment of three whorls (4.25 long by 1.75 in diam.) with about twenty-eight flexuous ribs and rather rounder, more shouldered whorls. If this is not a piece of a much larger specimen of *T. chipolana*, it indicates a different species.

Turbonilla pusilla C. B. Adams.

Chemnitzia pusilla C. B. Adams, Contr. Conch., p. 74, 1850.
Turbonilla pusilla Dall, U. S. Nat. Mus. Bull. No. 37, p. 128, 1889.

Older Miocene of the Chipola beds, N. W. Florida, Burns; living from Cape Hatteras to Barbados in 16 to 300 fathoms.

This species resembles *C. levis*, but is smaller. There are no spiral lines between the ribs. The living and Chipola specimens were practically identical in all essential characters.

Turbonilla interrupta Totten.

Turritella interrupta Totten, Am. Jour. Sci., 1st Ser., xxviii. p. 352, fig. 7, 1835.
Melania rufa Philippi, Moll. Sicil. i. p. 156, pl. ix. fig. 7, 1836.
Odostomia rufa Phil. var. *fulvo-cincta* Jeffreys, P. Z. S. 1884, p. 356.
Turbonilla Riisei Mörch?
Turbonilla viridaria Dall, Proc. U. S. Nat. Mus. vi. p. 332, 1883.
Turbonilla interrupta Holmes, Post-Pl. Foss. S. Car., p. 83, pl. xiii. figs. 4, 4 a, 4 b, 1859.
Dall, Rep. Blake Gastr., pl. xxvi. figs. 2, 2 b.
Turbonilla quinquestriata Holmes, *op. cit.*, p. 85, pl. xiii. figs. 5, 5 a, 5 b, 1859.
Turbonilla lineata Holmes, *op. cit.*, p. 85, pl. xiii. figs. 7, a-b.
Turbonilla subulata Holmes, *op. cit.*, p. 85, pl. xiii. figs. 8, a-b.
Turbonilla acicula Holmes, *op. cit.*, p. 86, pl. xiii. figs. 10, a-b.

Newer Miocene of the Cape Fear River, North Carolina, at the marl-beds of Mrs. Guion and Mrs. Purdy, Johnson; Pliocene of the Croatan beds, North Carolina; of the Waccamaw beds, South Carolina; of the Caloosahatchie, Shell Creek and Myakka River, Florida, Dall and Willcox; Post-Pliocene of South Carolina, Holmes, and of North Creek, Little Sarasota Bay, on the Gulf coast of Florida; living from Nova Scotia (Whiteaves, Hinkley) or the Gulf of Maine (U. S. Nat. Mus.) southward to the Antilles as far as Barbados and west on the north shore of the Gulf of Mexico to Galveston, Texas.

This fine and widespread species has also a wide range in time, but I have great confidence that no error has occurred in the identification of the Miocene specimens.

The character of the sculpture and the nature of its variations are worth a few words of explanation. The shell when fully adult and normally well developed has about twenty small, straight, smooth ribs extending with a slight obliquity from suture to suture. The interspaces vary from narrower to wider than the ribs and are spirally sculptured with fine spiral striæ. These striæ are the most variable feature in the shell. Sometimes they are almost evanescent, so that, except in certain lights, the shell seems devoid of spiral sculpture in the interspaces. More commonly the spirals are represented by fine scratches or incised lines, separated by wider interspaces, and with one especially marked, wider groove a little behind the middle of the whorl. In other cases there will be from two to six grooves regularly or irregularly spaced, beside some on the base. When these grooves are wide, even and regularly spaced, they give to the shell a reticulated aspect which is quite different from that of the forms in which the spacing of the grooves is irregular or there are but one or two of them. The different species of Holmes which the writer has placed in synonymy as above, are characterized by differences in strength and spacing of the spiral sculpture, which is, as a little reflection will convince any one who has worked over large collections, of but the slightest systematic importance in such a case as this. This species goes through a similar series of variations on the European coasts, and they have been named and renamed almost indefinitely.

The pillar is slender, usually straight and without a plait or tooth. The base is often quite smooth, but frequently spirally scratched or grooved. The ribs cease at the periphery, and if a groove happens to form here, there may be a punctate appearance to the interspaces between the anterior ends of the ribs. It may be worth while to say that a specimen white and fossilized shows the sculpture much better than it would if fresh and living, and frequently presents an aspect not offered by the living shell, and which exaggerates the apparent differences between the latter and the fossils. One who works on both in time recognizes this factor and allows for it; but to a paleontologist pure and simple, or a person who works only on living species, it might and sometimes does prove very misleading.

The more evenly reticulated specimens come very close to *T. reticulata*, while the more slender ones can hardly be separated from *T. obeliscus* C. B. Adams.

Turbonilla reticulata C. B. Adams.

Chemnitzia reticulata Ads., Contr. Conch., p. 75, 1850.
Turbonilla cancellata Holmes, Post Pl. Foss. S. Car., p. 84, pl. xiii. figs. 6, 6 a, 6 b, 1859.
? *Turbonilla caroliniana* Holmes, *op. cit.*, p. 86, pl. xiii. figs. 9, 9 a, 9 b, 1859.

Newer Miocene of the Cape Fear River, North Carolina, at Mrs. Purdy's and Mrs. Guion's marl-beds, Johnson ; Pliocene of the Croatan and Waccamaw beds in North and South Carolina, and of the Caloosahatchie beds of Florida ; Post-Pliocene of South Carolina at Simmons's Bluff, Holmes ; living off the coast of the Carolinas and southward to the island of Jamaica in the West Indies, in depths varying from low-water mark to over sixty fathoms, U. S. Fish Commission.

This species is smaller than *T. interrupta* and the spiral sculpture has the aspect of threads rather than grooved lines. The ribs usually stop at the periphery, but are sometimes faintly visible in front of it; the pillar is usually simple, slightly twisted and straight, but occasionally shows a distinct plait. A variety, *cingulata*, has one of the spiral threads behind the middle of the whorl swollen more than the others, as in Holmes's *T. speira*, which gives a shouldered aspect to the whorls, but this is an exceptional mutation. Specimens of the variety have been found in the Waccamaw and Caloosahatchie beds.

Turbonilla obeliscus C. B. Adams.

Chemnitzia obeliscus Adams, Contr. Conch., p. 72, 1850.

Pliocene of the Croatan and Caloosahatchie beds. Living from North Carolina to St. Thomas and Jamaica, West Indies, from low-water mark to 63 fathoms.

This species has exactly the characters of *T. interrupta*, except that it is proportionately more slender and usually a smaller shell. Prof. Adams's types at Amherst are fragmentary, but recognizable, and specimens named by him are in the National Collection.

Turbonilla multicostata C. B. Adams.

Chemnitzia multicostata Adams, Contr. Conch., p. 72, 1850.

Pliocene of the Croatan and Waccamaw beds. Living on the Carolina coast and in the Antilles.

The Southern specimens of this species are rather smaller than the fossils, but otherwise agree very well with them. *T. textilis* Kurtz is its nearest relative.

The pillar is simple; the extremely numerous and close-set, flattish ribs terminate not very abruptly at the periphery; the close-set, straplike spirals overrun and uniformly cancellate the ribs; the nucleus and three or more early whorls are smooth and polished. There is a tendency for the spiral band next the suture to marginate it, but this is more evident in some specimens than in others.

Turbonilla punicea Dall.

T. (*viridaria var. ?*) *punicea* Dall, Proc. U. S. Nat. Mus. vi. p. 332, 1883.

Newer Miocene of the Cape Fear River at Mrs. Purdy's marl-bed, Johnson; Pliocene of the Caloosahatchie beds, Florida, Dall; living on the coast of North Carolina, East and West Florida and the Bahamas from low-water mark to 30 fathoms.

This species has a little the form of a *Liostraca* and in life is dark-colored. As is usually the case, extreme Southern specimens are smaller than the more northern ones. The ribs do not cease abruptly on the base, the spiral sculpture is always rather feeble and sometimes obsolete, the pillar in mature specimens presents a well-marked plait, which in younger specimens lags behind the aperture and is invisible.

Turbonilla protracta n. s.

Plate 13, figure 11 a.

Newer Miocene of the Cape Fear River, North Carolina, from Mrs.

Guion's marl-bed, C. W. Johnson; Post-Pliocene of Simmons's Bluff, S. Car., Burns; living from the coast of North Carolina to Samana Bay, Santo Domingo, in 15 to 63 fathoms.

Shell with a smooth sinistral nucleus and six or more subsequent normal whorls; sculpture of numerous small, narrow, close-set, slightly oblique riblets extending from the suture nearly to the pillar or umbilical region, with spirally striate interspaces, the stronger striæ tending to appear as if punctate; whorls gently rounded, axially drawn out; suture appressed; aperture small, rounded in front; pillar slender, twisted. Lon. of shell 4.0; max. lat. 1.0 mm.

This pretty little species has been represented in my collection for a number of years by recent specimens. It is No. 612 of my list in Bulletin 37 U. S. Nat. Museum. The recent specimens are of a pale yet warm yellow brown, with a tendency to spiral lines of a darker shade.

It is somewhat singular that in the Older Miocene of the Chipola beds, though many small shells were collected, but two forms of *Turbonilla* have turned up. In the Red Bluff Eocene a *T. mississippiensis*, and in the Claibornian a *T. neglecta*, have been briefly described by O. Meyer (Geol. Surv. Alabama, pp. 69–70, 1886); the "*Chemnitzia*" *acuta* of the same writer is a *Bittium* allied to *Alaba* by several characters.

FAMILY CASSIDIDÆ (supplementary).

Genus CASSIS Lamarck.

The group including *Cassis* proper and *Cassidea* Bruguière (1789) had been previously named *Cassida* by Brunnich (Zoöl. Fund., p. 248, 1772), who, however, did not name any species in connection with his diagnosis of the genus. This name was adopted by Humphrey in 1797 to cover the Helmet shells, and very possibly was the source of *Cassidea* Brug. In the same place the genus *Tonna* is proposed for the shells since universally known under the name of *Dolium*, Lamarck. Gray, in Griffith's Cuvier, alludes to this name, which I have not seen elsewhere mentioned in the literature. Fortunately, as no species was mentioned in connection with the table of genera, we are not obliged to disinter these names, which for the rest long antedate those in common use.

Cassis (Phalium) globosum Dall.

Plate 20, figures 6, 11.

C. (*P.*) *globosum* Dall, Part I. p. 161, 1890.

Eocene of the Ocala nummulitic beds and Older Miocene of the Chipola formation in Florida.

In the Journal of the Academy of Natural Sciences, First Series, Volume VII., p. 146, 1834, Conrad briefly describes a species of *Cassis* under the specific name of *brevicostatus*, from the Claiborne sands. In 1865, in his catalogue of Eocene fossils (Am. Journ. Conch. i. p. 25), he refers it to *Semi-*

cassis. It has never been figured, and the description is insufficient to identify the species. After publishing my description of *C. globosum*, Mr. Aldrich suggested that this species of Conrad's was still unaccounted for, and, on searching the collection at Philadelphia, a shell was found under Conrad's name which proves to be identical with the *globosum.* Whether the ineffective description remaining unrepresented by a figure for more than half a century is entitled to precedence is doubtful, and I am contented to leave the question to the judgment of paleontologists.

Cassis (Phalium) Aldrichi Dall.

Plate 21, figure 2.

C. (*P.*) *Aldrichi* Dall, *op. cit.*, p. 162.

A figure of this interesting species is now furnished.

FAMILY CYPRÆIDÆ (supplementary).

Genus **TRIVIA** Gray.

Trivia pediculus Linné.

In Part I., p. 168, the existence of this shell in the Miocene was queried, but since that time Mr. Johnson has collected undoubted specimens of this species from Mrs. Guion's marl-bed in the Newer Miocene of the Cape Fear River, North Carolina.

FAMILY STROMBIDÆ (supplementary).

Genus **STROMBUS** Linné.

Strombus chipolanus Dall.

Plate 13, figures 1, 3.

S. chipolanus Dall, Part I. p. 176, pl. 4, fig. 1, 1890.

This species was only figured from an imperfect fragment taken from the silex beds, in Part I., and it has been thought best to illustrate the more perfect and complete specimen from the Chipola beds upon which the description was based. This shell attained a maximum length of 65 mm.

FAMILY TRIFORIDÆ.

Genus **TRIFORIS** Deshayes.

Section *Mastonia* Hinds.

Triforis perversa Linné, var. **nigrocincta** Adams.

Cerithium nigrocinctum C. B. Ads , Bost. Journ. Nat. Hist. ii. p. 286, pl. iv. fig. 11, 1839.
T. pervetsa var. *nigrocincta* Dall, Rep. Blake Gastr., p. 243, 1889.

Pliocene of the Waccamaw beds, South Carolina, the Shell Creek and the Caloosahatchie beds in Florida; living from Massachusetts southward to the Antilles in shallow water.

I have already discussed the relations of the American to the European forms of this species. The form and sculpture of the Pliocene specimens are absolutely identical with those of the recent specimens and vary through the same series of variations. If any difference can be detected, it is that on the average the size of recent specimens may be a little larger than the average of the fossils.

Triforis perversa Linné, var. **modesta** C. B. Adams.

Cerithium modestum Adams, Contr. Conch., p. 117, April, 1850.

Old Miocene of the Chipola beds, Florida, Burns; Pliocene of the Caloosahatchie beds on the Caloosahatchie River, Shell Creek and Alligator Creek in Florida, Dall and Willcox; living in the West Indies to Jamaica, Adams.

This form is smaller than *nigrocincta* and uniformly dark-colored in life; in the middle row the nodules are smaller than on the outer rows, the outline is slightly inflated. The living specimens intergrade with the Southern form of *nigrocincta*, and for that reason I regard it a Southern race or subspecies of the *nigrocincta-perversa* stock.

Triforis melanura C. B. Adams.

Cerithium moniliferum H. C. Lea, Trans. Am. Phil. Soc., 2d Ser., vol. ix. p. 269, pl. 37, fig. 2, 1845; not of Defrance.
Cerithium melanura C. B. Adams, Contr. Conch., p. 117, 1850.
Cerithium submoniliferum Orbigny, Prodr. Pal. iii. p. 83, 1852.
Triphoris moniliferum Emmons, Geol. Rep. N. C., 269, fig. 169, 1858.

Older Miocene of the Chipola beds, Florida; Newer Miocene of the Chesapeake formation, Petersburg, Virginia, Lea, and N. Carolina, Emmons; living from Cape Hatteras, N. Carolina, southward to the Antilles in shallow water.

This is very closely related to *modesta*, from which it differs in color, when living, in being more cylindrical and slender, while the spiral rows of nodules are not connected by any transverse ribbing, and are of a more even size than in that form. I have little doubt that it will be found in the Caloosahatchie Pliocene when more thoroughly searched.

Triforis distincta O. Meyer.

Triforis distinctus O. Meyer, Ala. Geol. Rep., p. 73, pl. i. figs. 5, 5 a, 1886.

Eocene of the Claiborne sands, Meyer; Older Miocene of the Chipola beds, N. W. Florida, Burns.

Though both diagnosis and figure are brief and unsatisfactory, there is little doubt that the Chipola species is that described by Meyer. His type is, however, a miserable, worn remnant of four whorls, wanting both apex and body-whorl. The characters of the base described by Meyer are those of immaturity; all or nearly all the species have a flattish base when young. As the shell grows older the line visible at the suture in the early whorls disappears under the margin of the subsequent whorl. The adult base has three strong threads, of which the one nearest the canal is simple, the others more or less nodulous. The canal is long and closed, the anal sinus distinct, but does not close; the lower lip is very patulous and projecting. The species is closely related to *T. mitella* Dall, from which it is distinguished by its rounder whorls, larger size when adult, and proportionally wider sutural channel. I owe to Mr. T. H. Aldrich the opportunity of examining Meyer's types of this and other species.

Triforis decorata C. B. Adams.

Cerithium decoratum Adams, Contr. Conch., p. 117, 1850.

Older Miocene of the Chipola beds, Florida, Burns; living on the north and east shores of the Gulf of Mexico and in the Antilles.

This is another species which is likely to be found on further search in the Pliocene of Florida. The Chipola specimens differ in nothing from the recent ones.

Triforis mirabilis Adams.

Cerithium mirabile C. B. Adams, Contr. Conch., p. 118, 1850.

Pliocene of Shell Creek, Florida, Willcox; living from Cape Lookout, N. Carolina, south to Florida and the Antilles.

This species has been confounded with *T. turris-thomæ* Orbigny, and perhaps should be assigned rather to the typical section of the genus than to *Mastonia*; but the distinction is not very weighty.

Triforis mitella n. s.

Plate 21, figure 10.

Older Miocene of the Chipola beds, Burns.

Shell very small, acute-conic, with an acute nucleus of about four nearly smooth whorls and nine subsequent whorls; each of the latter is a little smaller in front of the suture and enlarges forward so that the base of the whorl overhangs slightly the next in front; suture well marked, usually with a fine line in front of it, especially on the later whorls; sculpture of three spiral series of subequal, rounded nodules, the size of which, when they are perceptibly unequal, enlarges forward, the anterior row being largest and *vice versa;* they are so set on the whorl as to form slightly oblique transverse series, which are not connected by any ribbing, while the basal nodule is in advance in each set; base of the last whorl flattish or subconic, with one outer strong and one inner feebler, elevated thread; canal prominent, outer lip produced in front, with a sinus behind; both canal and sinus seem to remain open. Lon. of shell 3.3; max. diam. ⅝ mm.

This tiny species resembles *T. distincta* and *T. modesta*, but is smaller, more slender and more straight-sided. The peculiar eave-like manner in which the base of each whorl overhangs the suture is a special character. It seems to be a very rare species.

Triforis terebrata Heilprin.

A species too fragmentary for proper determination, and yet different from any of the preceding, was obtained by Burns in the Chipola marl. It is, perhaps, identical with *T. terebrata* Heilprin, from the Shiloh, N. Jersey, marls (cf. Proc. Acad. Nat. Sci. 1887, p. 405), with a careful drawing of which it has been compared. It bears a somewhat distant resemblance to a large, fine species inadequately described and inaccurately figured by Meyer under the name of *T. major*. Better specimens of *major* from Wahtubbee, Miss., show that its characteristics are a line of large, rounded nodules near the posterior suture, close to which is a sharp, somewhat undulated, elevated line, while at a little greater distance from the last is a smaller row of spirally compressed nodules over which runs a sharp-edged, elevated line; in front of the last and forming the edge of the anterior suture is a fine spiral line. The adult base is unknown; the young have it flattened with radiating, arcuate striæ and the margin deeply grooved or rabbeted so that the central region stands out from the whole base in a disk-like manner. This species must reach a length of 20 and a diameter of 4.5 mm. It has been referred to *similis* Meyer by De Gregorio, but is really a very distinct species, though this could not be learned from Meyer's work. *T. similis* Meyer of the Claibornian, described from a wretchedly worn fragment, appears to the writer to represent some broken middle whorls of a species of which the apex has been described by Meyer as *T. bilineatus* from the Red Bluff Eocene. The former name would best be retained, since the species is certainly not bilineate in the adult.

The *T. meridionalis* Meyer, based on another badly worn fragment, appears to be a distinct species; a fragment which even Meyer found too bad to name, but which seems to be a part of a young *meridionalis*, has been named from Meyer's figure *T. similis* var. *Meyeri*, De Gregorio. It is probably not connected with *T. similis*.

Triforis distructus Gregorio is a lapsus for *distinctus* Meyer.

In the Miocene, beside those before referred to, *T. bicostatus* Conrad (as of Emmons) is not a *Triforis*, but a *Cerithiopsis*, probably identical with *C. Emersonii* Adams, while *Cerithium* (*Sychar*) *moniliferum* Conrad is *Triforis melanura* Adams.

From the Pliocene of Costa Rica Gabb has identified the *T. turris-thomæ* of Orbigny.

Superfamily CERITHIACEA.

FAMILY CERITHIOPSIDÆ.

Genus SEILA A. Adams.

This genus is well separated from the genuine *Cerithiopsis* by characters found in the soft parts, as well as by the spiral ribbing which seems to characterize the shells. The animal (of *S. Adamsii*) has a short, broad foot, indented in the middle line in front, with a square-edged mentum narrower than the foot and extending beyond it; the operculum is shaped like a *Carinaria* shell in outline, but somewhat narrower, with the apex free, pointed and turned to the left. The attached surface of the operculum is deeply concave, so that in some old specimens it seems hollow. The tentacles are very short and stout, the proboscis seldom protruded; there is no muzzle like that of *Cerithium*. The jaw is composed of spade-shaped, rather large, close-set horny plates, the points projecting. The rhachidian tooth is sub-rectangular, wider than high, with two widely separated, strong, sharp cusps, and a much feebler, shorter and smaller one in the middle line between them. The major lateral is oblong, not very much wider than high, and has a strong recurved cusp with one large and one small denticle; the outer laterals, higher than wide, have two denticles at the point, which is less than half as wide as the base; formula $\frac{2}{2} + \frac{1}{2} \cdot \frac{1}{3} \cdot \frac{1}{2} + \frac{2}{2} \cdot$

The group appears to have an ancient lineage. *Cerithiopsis moreauensis* Meek from the Cretaceous seems to belong to it, while *C. constricta* H. C. Lea represents it in the Eocene, *C. clavulus* H. C. Lea and *C. annulatum* Emmons in the Miocene; *C. Adamsii* Lea in the Pliocene, Post-Pliocene and recent seas. *Cinctella* Monterosato, 1884, is a synonyme of *Seila* Adams, 1861, but *Lovenella* Sars, 1878, and *Læocochlis* D. &. M., 1874, are separated by good anatomical characters, the latter being nearest to *Seila*.

Seila Adamsii H. C. Lea.

Cerithium Emersonii var. C. B. Adams, Boston Journ. N. Hist. ii. p. 285.

Cerithium terebrale C. B. Ads., Boston Journ. N. Hist. iii. p. 320, pl. iii. fig. 7, 1840; Gould, Inv. Mass., 276, fig. 181, 1841; H. C. Lea, Am. Journ. Sci. xlii. p. 106, 1842; De Kay, New York Moll., p. 130, pl. viii. fig. 172, 1843; not of Lamarck.

Cerithium Adamsii H. C. Lea, Trans. Am. Phil. Soc., 2d Ser. ix., extras p. 42, 1845.

Cerithium terebellum Adams, Cat. Coll., p. 19, 1847; Sowerby, Thes. ii. p. 880, pl. clxxxiv. fig. 241, 1855.

Cerithiopsis terebellum Stm., Sh. of New Engl., p. 45, 1851.

Seila terebralis Dall, Bull. U. S. Nat. Mus. No. 37, p. 138, pl. 52, fig. 5, 1889.

Cerithium annulatum Emmons, Geol. Rep. N. Car., p. 269, fig. 161, 1858.

? *Cerithium clavulus* H. C. Lea, Trans. Am. Phil. Soc., ix., extras p. 42, pl. 37, fig. 89, 1845.

Older Miocene of the Chipola beds, Florida, Burns; Newer Miocene of Virginia and North Carolina, Lea, Emmons; Pliocene of the Croatan beds of North Carolina, of the Waccamaw beds of South Carolina, the Caloosahatchie, Myakka River and Shell Creek beds of Florida; Post-Pliocene of the Eastern United States and the Gulf coast; living from New Bedford, Mass., southward to Jamaica, West Indies, eastward to Samana Bay, Santo Domingo, and westward to San Antonio Bay, Texas.

The variety *attenuata* Dall has nearly the same distribution as the type, except in the extreme North, and is found in the Chipola beds. It differs from the type only in its smaller size and slightly more cylindrical form. The differences which led H. C. Lea to separate his *C. clavulus* from the recent form are proper only to the young, and may be found in the young of the recent specimens. *S. constricta*, according to Meyer's observations, while otherwise similar, has a different nucleus from the later forms. In the Eocene fossil it is long and axially sculptured. In the *S. Adamsii* it is smooth, flat-sided and rather acute-conical; in the closely allied *S. trilineata* Phil. of the Sicilian Pliocene, also recent in the Mediterranean, the nucleus is shorter and more swollen and irregular than that of the *S. Adamsii*, while in the form named *trilineata* from the Coralline Crag of Britain the nucleus is very short and swollen and has but two whorls, the first smooth, the second axially ribbed. It would appear, therefore, that we have to do with at least three closely related but probably distinct forms from the Miocene and later, while the Eocene form is quite distinct. *Cerithiopsis quadristriaris* Meyer and Aldrich from the Eocene of Newton, Mississippi, seems to me distinct from *S. constricta*, though somewhat similar in sculpture. It has four threads, of which the inner pair are smaller, and give the whorl a constricted look not seen in Meyer's figure. It is also less cylindrical than *S. Adamsii.*

There is no question as to the identity of *S. annulatum* Emmons with the recent *S. Adamsii.* Adams, when he found his specific name *terebrale* had been preoccupied, suggested *terebellum*, which was adopted by Stimpson and Sowerby, but H. C. Lea's *Adamsii* is earlier by two years, his paper in the Trans. Am. Phil. Society having (as we have discovered after much search) been published early in 1845, though read in 1843.

Genus **CERITHIOPSIS** Forbes and Hanley.

Subgenus **Eumeta** Mörch.

Cerithiopsis (Eumeta) subulata Montagu.

Murex subulatus Mont., Test. Brit. Suppl., p. 115, pl. xxx. fig. 6, 1808.

Cerithium punctatum Philippi, *non* Linné.

Cerithium Emersonii C. B. Adams, Bost. Journ. N. Hist. ii. p. 284, pl. iv. fig. 10, 1838; Gould, Inv. Mass., p. 275, fig. 180, 1841.

Cerithium bicostata Emmons, Geol. Rep. N. Car., p. 270, fig. 162, 1858.

Triforis bicostatus Conrad, Cat. Mioc. Sh., Proc. Acad. Nat. Sci. Phila. 1863, p. 567.

Cerithiopsis subulata Dall, Blake, Gastr., p. 252, pl. xx. fig. 4, 1889; Bull. U. S. Nat. Mus. No. 37, p. 140, pl. 52, fig. 1, 1889.

Newer Miocene of North Carolina, Emmons; Pliocene of the Caloosahatchie, Dall; living along the coast of North America from Cape Cod to Yucatan, and in the Antilles to Grenada, in 2 to 15 fathoms.

This very elegant species is readily recognized, and seems to be rarer in the fossil than in the recent state.

Subgenus **Cerithiopsis** s. s.

It may be noted that the figure of the operculum of this genus in Forbes and Hanley's British Mollusca, and which is copied by H. and A. Adams in the Genera of Recent Mollusca, is erroneous. For a correct figure see Jeffreys' British Conchology, vol. iv., pl. iv. fig. 5.

Cerithiopsis tubercularis Montagu var. **floridana** Dall.

Pliocene of the Caloosahatchie beds; living on the coast of Florida at Key West, Hemphill.

This form differs from the British *C. tubercularis* in being more inflated and having the axial sculpture closer and more prominent than the spiral ridges. The recent specimens referred to it differ also in color, having the sutural region dark purplish brown and the peripheral nodules nearly white, while the rest of the shell is the usual dark yellowish brown. It is possible this shell should be referred rather to *C. Greenii* than *C. tubercularis*, yet it seems intermediate between them. *Cerithium Lordlyi* Gabb, from the Pliocene of Costa Rica, may probably prove to be a variety of *tubercularis*.

Cerithiopsis Greenii C. B. Adams.

Cerithium Greenii C. B. Ads., Bost. Journ. N. Hist. ii. p. 287, pl. iv. fig. 12, 1839; Stimpson, Sh. N. Engl., p. 37, 1851.

Bittium Greenii H. and A. Adams, Genera Rec. Moll. i. p. 287, 1854.

Cerithiopsis Greenii Dall, Blake, Gastr., p. 251, 1889; Bull. U. S. Nat. Mus. No. 37, p. 138, pl. 52, fig. 2, 1889.

Pliocene of the Caloosahatchie River, Florida, Dall; Post-Pliocene of Sankoty Head, Nantucket, Verrill; living from Prince Edward's Island on the north to Santo Domingo on the south, and west to San Antonio Bay, Texas; also at Bermuda.

This species appears sufficiently well distinguished from the *C. tubercularis* both in shell and animal.

Cerithiopsis scariphus n. s.

Plate 22, figure 5.

Pliocene of the Caloosahatchie beds, rare; Dall.

Shell small, subcylindrical, slender, with a smooth styloid nucleus of about four whorls and eight or nine subsequent whorls; sculpture of a posterior smaller, two peripheral larger and one smaller basal revolving ridges, upon the last of which the suture is wound, reticulated by numerous finer, slightly more crowded, sharp, axially directed, elevated lines, and slightly nodulous at the intersections; whorls slightly rounded, base smooth, somewhat excavated; aperture subquadrate; pillar and canal short, simple; suture very distinct. Lon. of shell 4.75; max. diam. 1.2 mm.

This recalls *C. tubercularis*, but is smaller, more slender, with sharper and finer sculpture and a different base. The nucleus is proportionately larger than in *C. tubercularis*, and the nodules at the intersections hardly developed. Only a single specimen was obtained.

Section *Metaxia* Monterosato.

Cerithiopsis metaxæ Della Chiaje var. tæniolata Dall.

C. metaxæ, var. *tæniolata* Dall, Blake, Gastr., p. 256, 1889.

Pliocene of the Caloosahatchie beds.

A single fragment of this very interesting form was found in the marl.

Cerithiopsis Aldrichi Meyer appears to be a good species of *Metaxia*. It is from the Red Bluff Eocene. It is not much larger than *C. metaxæ*, but exhibits a very remarkable character in having five or six nuclear whorls exhibiting very beautiful arcuate striation. No other species of the group has so large a nuclear part. I have been able, through the courtesy of Mr. Aldrich, to examine Meyer's types, and thus to clear up the uncertainty which has hung about several of the Cerithiacea.

Cerithiopsis (*Lovenella*) *nassula* has been identified by Meyer from the type of Conrad at Philadelphia. It is the same species which was afterward described, from a young tip, as *Cerithiopsis Jacksonensis* Meyer. In this species, as in many others, the apical whorls are more rounded than the later ones of the same specimen, and when a tip with a few apical whorls is compared with a body-whorl or more broken off the other end of the shell, the two look quite different. Fragments of large specimens from Moody's Branch, near Jackson, Miss., and from Newton, Miss., were afterward identified by Meyer with his *C. Aldrichi*—a singular error, since the two belong to different subgenera. Another *Lovenella* much resembling *C. nassula* is *C. Langdoni* Aldrich. So far as the specimens now available go, I hesitate to unite them; nevertheless, it is probable they will eventually be regarded as varieties of *C. nassula*.

Two other species of *Cerithiopsis*, which do not seem to be described, appear in the material sent by Mr. Aldrich, who will name them later. They are both Eocene and belong to the typical group in the genus.

It is probable that *Trachyschœnium* Cossmann is synonymous with *Metaxia*. *Cerithiopsis alternata* Gabb, from the Téjon Eocene of California, judging by the figure, might be referred to *Metaxia*.

Beside the species of *Cerithiopsis* mentioned above, I find in the literature a *C. bicostellatus* Conrad which has not been figured or identifiably described. It is from the Eocene of St. Matthew's parish, Orangeburg district, South Carolina, and was described as a *Cerithium* as follows: "Turreted; volutions eight or nine, angular and carinated below the middle; body-whorl bicarinated. Length, ⅝." *C. claibornensis* Conrad appears to be a fragment of a *Cerithium*. *C. solitaria* Conrad is a *Cerithium* and not a *Cerithiopsis*. De Gregorio refers *Cerithium tombigbeensis* Aldrich to *solitaria*, but the figure of the latter does not at all resemble Aldrich's shell. The above are all Eocene forms. *C. oregonensis* Conrad was first recorded as an unidentifiable fragment by that author, who at a later date named his own extremely bad figure of it. It is uncertain whether it came from the Eocene or the Miocene Astoria bed, as Conrad had fossils from both and did not discriminate them. *C. Emmonsi* Conrad, from the Miocene of North Carolina, is a Columbellid belonging to *Seminella* or *Æsopus*, which was figured as an unnamed species of *Cerithium* by Emmons. From the California Pliocene Carpenter has described a *Cerithiopsis assimilata*, and from the Costa Rica clays of the same age a species has been described as *Cerithium limonensis* Gabb which appears to be a *Cerithiopsis*. Another species described in Gabb's posthumously published paper under the name of *Cerithium caribbæum* recalls *Cerithiopsis*, but is probably a species of *Oscilla*. His *Cerithium moenensis* is an *Alaba* not far from *A. tervaricosa* Adams.

Family CERITHIIDÆ.

Genus **BITTIUM** (Leach MS.) Gray.

I have not been able to confirm Monterosato's supposition that this name had been used for a genus of Crustacea, either before or after 1847, and conclude that some mistake has misled him. At all events, one can reasonably claim the right to retain the name until the preoccupation of it is established by definite citations.

This group includes a variety of small Cerites which have no posterior notch to the aperture and no defined canal; the outer lip is patulous and the last whorl usually contracted and overhung by its predecessor. The species are extraordinarily variable in sculpture, the typical forms are varicose, but the majority are not distorted by the varices, which are frequently feeble and few in number. Some species like *B. alternatum* Say have the varices so thin that they are only visible as an impressed line. *Diastoma* differs from *Bittium* by having a notch or feeble posterior canal in the outer lip. Some short, ovoid species like *Sandbergeria valmondoisiensis* Cossmann are almost Rissoid in form. That author has referred them to *Sandbergeria* as a section *Aneurychilus*, but to the writer they seem rather more closely related to *Bittium*. *Alaba* is another form which differs from *Bittium* in but few characters. *Litiopa* is much modified by its pelagic habit, but with *Alaba* forms a group which can hardly be regarded as far distant from the *Cerithiidæ*. The sections and subgenera into which the Lamarckian Cerites have been divided, subtraction made of forms like *Triforis* and *Cerithiopsis*, are not separated from one another by any trenchant differences, but are merely conveniences for dividing an overloaded genus. Some small, slender and delicate forms referred to a subgenus under *Alaba* by Adams with the name *Styliferina*, are probably closer to *Bittium* than to typical *Alaba*.

Bittium chipolanum n. s.

Plate 21, figure 15.

Older Miocene of the Chipola beds, Burns.

Shell acute, with four larval, at first smooth, afterward spirally threaded, rounded whorls, and about ten subsequent flattened whorls, widest immediately behind the suture; surface spirally grooved, with the interspaces wider than the grooves, and one especially wide one usually at the periphery; transverse sculpture of about sixteen nearly straight, rounded riblets, usually beginning in front of the suture and growing wider and stronger to the periphery, where they cease abruptly, or they may be obsolete or entirely absent; they are usually faint or absent on the last whorl, even when they are strong on the rest of the shell; base strongly, spirally grooved and threaded, with a single swollen, ill-defined varix about half a turn behind the outer lip; there are no varices on the other whorls except in rare cases; suture distinct, applied below the periphery so that a single thread intervenes behind the suture and in front of the ends of the ribs; canal short, straight, wide, shallow; outer lip thin, not reflected; inner lip slightly callous; pillar somewhat curved, slender; throat slightly or not at all lirate. Lon. of shell 13.0; max. lat. 3.75 mm.

Bittium chipolanum var. **Burnsii** Dall.

Plate 21, figure 18.

Shell more slender, with several varices. Lon. 13.5; max. lat. 3.0 mm.

This form has variations in the transverse sculpture similar to the type, but the last whorl is proportionally smaller and the spire more slender and drawn out. Both appear to be extremely abundant in the Chipola beds.

Bittium permutabile n. s.

Plate 21, figure 17.

Older Miocene of the Chipola beds, Burns.

Shell acute, with two very minute, smooth, rounded nuclear whorls and about ten subsequent, also rounded, whorls, with the periphery almost midway between the sutures; suture closely appressed, distinct, not marginate, varices irregular, generally two or three in number, distributed along the spire; spiral sculpture of numerous fine, close-set, sometimes alternated, rounded threads; transverse sculpture of about nine prominent, rounded riblets, bigger at the periphery, narrowing and becoming feeble each way toward the suture; base spirally threaded, aperture with a feeble canal, short and twisted pillar and non-lirate throat; outer lip thin, simple, arched forward; inner lip slightly washed with callus; last varix strong and prominent. Lon. of shell 13.5; max. lat. 3.75 mm.

This species differs from the preceding by its more rounded whorls, fewer and much more prominent ribs, and slenderer spire; the last whorl also is proportionately smaller. It was rather abundant in the marl.

Bittium Cossmannii n. s.

Plate 21, figure 16.

Older Miocene of the Chipola beds, Burns.

Shell subconic, with two and a half smooth, rounded nuclear whorls and six or seven rapidly increasing, inflated subsequent whorls; varices numerous, usually two or three on each of the larger whorls, with three small, peripheral, wavelike, transverse riblets between each pair of varices, or the riblets may be obsolete; spiral sculpture of fine striæ with wider interspaces, forming fine, flattish threads, with one wider flat thread just in front of the periphery, and in advance of that one another on which the suture is wound; suture very distinct, deep, sub-appressed; periphery nearer the anterior suture; base spirally threaded, rounded; aperture wide, pillar very short and feeble, canal short, wide; outer lip arched, slightly thickened, not lirate within, a thin wash of callus on the inner lip. Lon. of shell 11.0; max. lat. 5.5 mm.

This species recalls *Mesostoma*, but is obviously a *Bittium*. It is the largest and most inflated species of the group. The body-whorl is remarkably large and the varices numerous. It was found rather abundant, though only one fully adult specimen was collected, from which the figure has been drawn. It is respectfully dedicated to M. Cossmann, of Paris, France, whose distinguished researches on the Parisian Eocene are well known.

Bittium annettæ n. s.

Plate 20, figure 3.

Newer Miocene of the Cape Fear River, North Carolina, C. W. Johnson.

Shell small, with two nearly smooth larval whorls and about seven subsequent, sharply sculptured turns; spiral sculpture of about six flattened threads with narrower interspaces on the base, behind that on the last whorl five sharply elevated threads with wider interspaces; on the preceding whorls three of these persist, sometimes showing the others faintly, intercalated; these are crossed, except on the base, by sharp riblets of about equal size, equally spaced, and somewhat nodulous at the intersections; the lines of growth are quite distinct. The transverse ribbing stops short of the sutures, which consequently have a channelled appearance, though really closely appressed; there is a single obscure, swollen varix behind the outer lip about one-third of a turn; base rounded, aperture subovate; outer lip thin, its posterior angle sharp; pillar thin, passing into the peristome almost insensibly; canal obsolete, a thin callus sometimes spread over the body. Lon. of shell 5.75; max. lat. 2.5 mm.

This species, though larger and more sharply sculptured, is obviously the precursor of *B. alternatum* Say of the Post-Pliocene and recent fauna.

Bittium podagrinum n. s.

Plate 21, figure 12.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox.

Shell small, swollen, with three small, inflated, smooth and polished nuclear and four rapidly increasing subsequent, reticulated whorls, the last third of the last of which is contracted so as to be smaller than the antecedent coil of the shell; spiral sculpture of, on the body-whorl, about four obscure grooves, separating wider, somewhat rounded, flattish interspaces, and cutting more or less distinctly the numerous flattened, straight riblets which cross from suture to suture, sometimes nodulated at the intersections, but more commonly flattened; upper whorls of the spire flattened, the penultimate whorl swollen, the last whorl contracted in its later half, which is destitute of riblets and shows an obscure varix; base spirally sulcate or sometimes nearly smooth; aperture ovate, oblique, the inner lip raised and nearly continuous with the peristome; canal practically obsolete; pillar not distinct from the raised labrum; outer lip thin, simple; throat non-lirate; suture very distinct. Lon. of shell 4.75; max. lat. 2.75 mm.

This curious little species varies in obesity, but always has a swollen look. It would probably be referable to *Aneurychilus*, if that be regarded as a section of *Bittium*.

Bittium (Diastoma?) varium Pfeiffer.

Cerithum varium Pfr., Arch. f. Naturg. 1840, p. 256, No. 139.

Cerithium gibberulum C. B. Adams, Proc. Bost. Soc. Nat. Hist. 1845, p. 5; Sby., Thes., p. 876, No. 118, figs. 210, 211.

Bittium varium Mörch, Mal. Blatt. xxiii. p. 96, 1876; Dall, Bull. U. S. Nat. Mus. No. 37, p. 140, 1889.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; Post-Pliocene of North Beach, Florida, Dall. Living from Chesapeake Bay to St. Thomas, W. Indies, Dall, Krebs, Adams, etc.

This species is frequently confounded with *B. alternatum* (or *nigrum*). Its obliquely set mouth, angulated at both ends, especially behind, has suggested that it may properly be referred to *Diastoma*, but this state of the shell is confined to fully grown adult specimens; the young show nothing of the posterior sinus.

Bittium (Styliferina ?) priscum Dall.

Plate 11, figure 6.

Part I. p. 189, pl. xi. fig. 6, 1890.

Older Miocene of the Orthaulax bed at Tampa, Florida, Shepard and Dall.

Shell small, slender, the specimens decollate; the remainder shows seven rounded whorls with a distinct suture, two or three raised spirals on the whorls and three more on the base. These are crossed by a variable number of slightly arched riblets, which are frequently nodulous at the intersections; in the perfect state these nodules were sometimes very prominent; aperture short, rounded, with an obsolete canal, reflected inner lip with a chink behind it; a short and obscure pillar and a short, thin, sigmoid outer lip without liræ. Lon. of shell figured 7.0; max. diam. 2.75 mm.

This species is represented only by siliceous pseudomorphs, which are not very satisfactory in so small a shell; but from the fragments collected it seems different from any of the Chipola species. The specimen figured was defective in the region of the pillar; subsequently collected specimens give the characters of the canal and outer lip. It seems to have run through a range of sculpture-variation very similar to that exhibited by the species previously described. It would seem to have been in the ancestral line from such species as *B. boiplex* and *B. Adamsi* Dall.

Bittium (Styliferina) boiplex n. s.

Plate 21, figure 14.

Chipola older Miocene, Burns.

Shell small, slender, acutely pointed, strongly sculptured, with two minute, smooth and ten subsequent rounded whorls; earlier whorls with only spiral sculpture, which later becomes sharp, elevated threads alternating in strength, with three strong spirals on the base, on the posterior of which the distinct, appressed suture is applied; the spiral sculpture crosses numerous concavely-arched riblets, which may be strong or obsolete; there are also numerous well-marked, rounded varices irregularly distributed both in position and number; the whorls are well rounded, the aperture ovate, with hardly a trace of canal; a short, arched pillar, thin, simple outer lip, and no lirations in the throat. Lon. of shell 8.5; max. diam. 1.75 mm.

This is one of those forms which unite sections together, showing characters of *Alaba*, *Bittium* and *Styliferina*, impartially mixed. It is without doubt of the same stock as *B. Adamsi* Dall and *B. cerithidioides* Dall, and recalls *Bittium Kœneni* Meyer, of the Jackson and Shell Bluff Eocene. The latter is, however, much smaller, if Meyer's account be based on a mature individual, and *B. Adamsi* is also smaller and has a smoother, more regular and somewhat different sculpture.

B. boiplex varies in slenderness and in the relative strength of the different elements which make up its sculpture, as do all the species of this group. It appears to be very common in the Chipola marl.

Bittium (Styliferina) cerithidioides Dall.

Plate 16, figure 8.

Bittium (*Alaba?*) *cerithidioides* Dall, Blake, Gastr. Rep., p. 258, Mar., 1889; U. S. Nat. Mus. Bull. 37, p. 140, 1889.
Compare *Chemnitzia dubia* Orbigny, Moll. Cuba, i. 226, t. xvii. figs. 4, 6, 1842.

Older Miocene of Bowden, Jamaica, W. I., Bland in Nat. Museum; Pliocene of the Caloosahatchie, Florida, Dall, and Costa Rica, Gabb; Post-Pliocene of Simmons's Bluff, South Carolina, Burns; living from Cape Lookout, North Carolina, to Samana Bay, Santo Domingo, U. S. Fish Commission.

This elegant little shell passes unchanged from the older Miocene to the present day. I have not been able to compare a specimen of Orbigny's species, which is obviously one of the same group, but it appears to be more slender and with fewer, less inflated whorls in the same length, if his figure is to be trusted. He speaks of finding it not only in the Antilles, but also at Rio Janeiro, and it may be that there has been a confusion between two species, one Brazilian and one Antillean, and that a Brazilian specimen was selected for figuring. *Bittium canaliculatum* Gabb, from the Pliocene of Costa Rica, is very similar.

Bittium (Styliferina) Adamsi Dall.

Bittium (*Alaba*) *Adamsi* Dall, Blake, Gastr. Rep., p. 258, Mar., 1889; Bull. U. S. Nat. Mus. 37, p. 140, 1889.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; living from Cape Hatteras, North Carolina, to Haiti, W. I., in moderate depths of water.

This species has the size and form of *B. cerithidioides*, with the sculpture of *B. boiplex*. It is not unlike *B. asperoides* Gabb, from the Costa Rica Pliocene. *Bittium Kœneni* Meyer (Alabama Geol. Rep., p. 70, pl. 2, f. 12, 1886) is an analogous species from the Eocene of the Jackson group, in which the ribbing is more oblique and nodulous and the shell itself very much smaller. It bears a suspicious resemblance to *Melania claibornensis* Heilprin, 1879. Other species of *Bittium* from the Tertiary of North America are *Cerithium Collinsii* Gabb and *C. triseriale* Gabb, from the Pliocene of Costa Rica. *Chemnitzia modesta* Orb., referred by Gabb to *Bittium*, is a *Turbonilla*. *Cerithium curtum* H. C. Lea may be the tip of a small *Bittium*, but is hardly recognizable. *Bittium costatum* Gabb, from the Pliocene of Costa Rica, may be a valid species.

Genus **CERITHIUM** Bruguière.

Cerithium Bruguière, Enc. Meth. 1789, *non* Lamarck, 1799.

The subdivisions into which this group have been divided are worthy of more extended comparative study than they have received, but it cannot be attempted here. I may observe, however, that, in sorting over large numbers of specimens of one species, either recent or fossil, it will be noticed that there are two sets as it were, otherwise similar, one much more slender than the other. This may be a sexual difference; it is observable in *Bittium* and *Seila* also. The principal variations of the species are: 1st, size, there being in almost any large lot a few or possibly many dwarfs, otherwise similar—recalling the difference of size in *Cypræa;* 2d, in the intensification of (*a*) the transverse wavy sculpture, which in any species which has it may be strong, weak or wholly absent; (*b*) the nodulations or tessellations of the primary spiral bands or revolving ridges, which vary in the same species from obsolete to very sharp and prominent; (*c*) the prominence of the primary bands, which is very variable, apart from the nodules they may bear. The secondary fine striation, as in *Buccinum*, is much more constant in its features than the coarser sculpture.

The scarcity of Cerites in the American Tertiary has been noted as a characteristic of the fauna, but this is due rather to our ignorance of the Tertiary faunæ of North America than to a real absence of species of *Cerithium*. Some enormous species are found in the early Eocene Prairie Creek beds, but they are badly preserved and have only lately been recognized as Cerites. It is probable, however, that no such thick beds of species of this genus as are found in exotic Eocene strata occur in the American Tertiary.

Quite a number of fossils have been referred to *Cerithium* in the American faunæ which appear to belong elsewhere. Thus *Cerithium* (*Cerithidea*) *agnotum* and *C. persum* de Greg., *C. striatum* Lea and its synonymous *Proto vetusta* Conrad, are not Cerites, but are apparently species of *Pseudomelania*. *C. dislocatum* Say and *C. carolinensis* and *unilineatum* Conrad should be referred to *Terebra*. *C. Fremonti, nodulosum* and *tenerum* Hall, from brackish-water-beds of the West, collected on Fremont's expedition, are Melanians of the genus *Goniobasis*, as is probably *Cerithium texanum* Heilprin.

To the Melanians also must be referred the *Compsopleura trinodosa* (= *Scalaria trigemmata* Conr.) of Conrad, which is a *Goniobasis* and has nothing to do with *Scala*.

To *Cerithidea* proper must be referred *C. californicum* Haldeman and *C. sacratum* Gould of California. *C. misgum* de Greg. from Claiborne is a fragment of an *Astyris*, and *C. miturum* of the same author the tip of an *Anachis*. *C. lucrosum* de Gregorio is regarded by that author as identical with *C. agnotum*. *C. dœdaleum* H. C. Lea is a *Turbonilla*; *C. decisum* and *mediale* of Conrad, miserable fragments which that writer afterward referred to *Fusus;* *C. siliceum* Conrad is doubtfully referable to *Cerithium*, and *C. sagenula* Conrad (in Morton's Synopsis, App.) is a list-name for which no figure or description is extant. *Cerithium cornutum* Heilprin is a *Pyrazisinus*.

A group of very interesting species which can hardly be said to be established have been described from the Haitian Miocene by Gabb, who has given brief diagnoses, but no figures. They are *C. dentilabrum*, *dominicense*, *microlineatum*, *obesum*, *prismaticum*, *simplex*, *suprasulcatum*, *turriculum*, *venustum* and *Yaquensis*. *C. uniseriale* Sowerby, also from Santo Domingo, has been figured by Guppy, and is included in Gabb's list, where *C. pictum* Wood and *C. plebeium* Sowerby (the last, with *C. obesum*, also figured by Guppy) also find a place. Gabb has also described a *C. laeviusculum* from Peru, and a *C. mexicanum* from the Cretaceous of Sonora.

These eliminations made, we have left for the Tertiary of the United States only the following-described species: Eocene, *C. georgianum* Lyell and Sowerby, from North Carolina; *C. solitarium* Conrad, *C. vinctum* Whitfield sp., *C. Whitfield* Heilp. and *C.* (*Potamides*) *tombigbeënsis* Aldrich, from Alabama; Miocene, *C. precursor* Heilprin, from the Orthaulax bed, Tampa, Florida; *C. hillsboroensis* Heilprin, from the Tampa Orbitolite bed; Pliocene, *C. ornatissimum* Heilprin and *C. atratum* Born, from Florida; and a few Post-Pliocene and recent species. To this meagre catalogue, as will be seen, substantial additions will be made in the present paper.

Cerithium georgianum Lyell and Sowerby.

C. georgianum L. and S., Quart Journ. Geol. Soc. i. p. 439, 1845. Figured.

Uppermost Eocene (or lowest Miocene) bed of Jacksonboro', Scriven County, Georgia; older Miocene of the Orthaulax bed, Ballast Pt., Tampa Bay, Florida, Dall.

Two specimens of a fossil which seems to differ but slightly from Sowerby's description in Lyell's paper were found at Ballast Point. Unfortunately, the aperture is imperfect in one and wholly wanting in the other. The principal point of difference is that *C. georgiana* is described as having "rather obsolete" transverse ribs, while the Tampa specimen has the ribs fairly well marked. But we all know that this, especially in *Cerithium*, is a variable character. As Sowerby's description and figure are not accessible to many, I give a brief diagnosis of the species. Shell of ten or more whorls, with about two varices on each, rather regularly disposed on each side of the shell; between each two varices are 5–7 narrow, flexuous, rounded, little-elevated ribs, which cross the whorls from suture to suture, or may be obsolete in front of the periphery; the spiral sculpture on the spire is composed of three primary spirals on the middle of the whorl, with wider interspaces, each occupied by a small intercalary thread; behind the posterior primary spiral are three small threads next the suture; whorls rounded, suture appressed; on the base are three or four more primary spirals, which, with the three above the periphery, become much elevated on the last half of the last whorl, while the transverse sculpture on the last whorl is feeble or obsolete; the base and aperture somewhat resemble the same parts in *C. muscarum* Say; where the transverse and spiral sculpture intersect, the spirals, which overrun the others, become prominent and sharp, though not exactly nodulous. Alt. of shell about 30; max. diam. 10 mm.

I have elsewhere in this paper given my reasons for supposing the Jacksonboro' horizon to be early Miocene rather than Eocene, as supposed by Lyell, yet in any case it lies close to the border-line between the two periods.

Cerithium caloosaënse Dall.

Plate 15, figures 9, 11; var., 11 b.

Cerithium ornatissimum Heilprin, Trans. Wagn. Inst. i. p. 90, pl. 8, figs. 18, 18 a, 1887. Not of Deshayes, Mém. Soc. Géol. de France, t. 4, p. 320; t. 5, p. 41, pl. 17, f. 10, 1842, and Pictet, Terr. Cret. de St. Croix, p. 290, pl. 71, f. 10, 1862.

Pliocene of the Caloosahatchie beds and Shell Creek, Willcox.

This fine species has two very minute nuclear whorls, which are nearly smooth, followed by 23 slowly enlarging subsequent turns. It reaches a length of 80 mm., with a maximum diameter of 21 mm. The slender (? male) form measures 68 by 15.5 mm. It has the aperture of a *Vertagus*, but is totally destitute of any ridge, groove or eminence on the pillar from the beginning. Its characteristic features are (1) a fine, sharp grooving, covering most of the shell; (2) a thickened spiral band in front of the suture, especially on the last whorl, followed by, counting forward, smaller primary, usually nodulous bands grouped: 2, 3, then a groove circumscribing the base, 2, 1, 1, to the canal; between the primaries are secondary rounded threads, merging variably into the general striation, and frequently wavy; (3) transverse, often strong but obscurely defined waves to the number of about thirteen on the penultimate whorl; these may be nearly obsolete; they begin in front of the suture and extend more than half way across the whorl. The nodulations on the smaller primaries may be wavy, sharp and squarish, or rounded and beadlike; in the variety *Heilprini* (fig. 11 b) they are absent from the spire and few and feeble on the last whorl. Until a large number are compared, the extremes seem very distinct, but the gradations from one to the other form a continuous series. The specimen of the variety figured is enlarged on the plate; it measures 40 mm. long (slightly decollated) and 11 mm. in diameter.

This is one of the finest species known from our Tertiary, though there is a form known chiefly by imperfect molds in the Ocala limestone that must have nearly equalled it in beauty and size.

The name proposed by Prof. Heilprin being preoccupied by a valid species described from the Gault of France by Deshayes, I have supplied another.

Cerithium ocalanum n. s.

From the Orbitoides limestone at Martin Station, Florida, in the form of silicious pseudomorphs; from the nummulitic limestone of Ocala, Florida, in the form of molds, collected by Joseph Willcox, Esq.

Shell large, pointed, many-whorled, somewhat distorted by numerous swollen varices; spiral sculpture of from three to five primary ridges, which are smooth over the varices, but elsewhere generally beaded; between these are smaller secondary, often wavy, threads, separated from the adjacent primaries by one, two, or even three extremely fine simple tertiary threads. The varices number at least one to the whorl, they are prominent and swollen, but not sharply defined; they grow narrower as the shell becomes more nearly adult. The base is spirally threaded with faint beading, the pillar smooth and without plait or groove, the canal distinct and recurved; the sutures are distinct and appressed, whorls moderately rounded. The shell measured 50 to 60 mm. in length, with a diameter of about 14 mm.

The specimens in hand are so fragmentary as to render it inadvisable to figure them, as better ones will, no doubt, soon be obtained. It is certainly distinct from any species known in our Tertiaries, and of a type not recalled by any of our recent species, having a curious general resemblance to a *Colubraria*, owing to its compact sculpture and swollen varices. The transverse sculpture seems confined to the beading and varices.

Cerithium Burnsii n. s.

Plate 14, figure 12.

Newer or Chesapeake Miocene of the upper bed at Alum Bluff on the Chattahoochee River, Florida, Frank Burns.

Shell solid, strong, nuclear whorls lost, with ten or more subsequent whorls; spiral sculpture of seven or eight revolving, flattened threads, with narrower, channelled interspaces, variable in size; one at the periphery, another on which the suture is wound, and one or two more on the base, being larger than the rest; the surface of the specimens is somewhat worn, but there are hardly any indications of fine spiral striation; the spirals on the last whorl are somewhat wavy, that on the basal margin and those near the suture on the last whorl have some tendency to become nodulated; transverse sculpture of about eight narrow, strong, rounded ribs extending across the whorls and angulated at the intersection of the peripheral spiral; one of these on each whorl is a little larger than the others, but the only conspicuous varix is that at the end of the first third of the last whorl; suture distinct, appressed; base somewhat excavated; pillar short, arched, simple; canal narrow, deep, recurved; body with a strong callus with its edge free; outer lip thickened, arched, with faint sulci inside corresponding to the sculpture; at the junction with the body is a moderate sinus and sub-sutural, elevated ridge which enters the throat some distance. Length of shell 55; max. diam. 20 mm.

This fine species is represented by two specimens, of which one is imperfect, collected by Mr. Burns and now in the National Museum.

Cerithium platynema n. s.

Plate 14, figure 11.

Uppermost Eocene (or lowest Miocene) shell limestone at Jacksonboro', Scriven Co., Georgia, Prof. W. B. Clark.

Shell represented in a limestone chiefly composed of fragments of small Pelecypoda, by molds from which gutta-percha casts were made and the description and figure taken from these.

Shell large, nucleus lost, with eight or more subsequent, rounded whorls; transverse sculpture of about fifteen narrow, little-elevated, rounded ribs, which become less evident toward the sutures and are separated by equal or wider interspaces; these are crossed by fine, even, close-set spiral secondary threads, by three stronger primary, flattened threads near the middle of the whorl, and by a fourth strong, plain primary thread on which the suture is wound; toward the end of the last whorl the primaries are somewhat more elevated and the secondaries less prominent; the intersections of the ribs and primary spirals are prominent, but hardly nodulous; on the last whorl a new, flattened primary appears just in front of the suture; the varices are perceptible, but not prominent on the spire. Lon. of specimen figured 26; max. diameter 11 mm. Another stouter specimen measures 30 by 15 mm.

The sculpture of this species is so well marked and peculiar that it cannot be mistaken for any of the others, even without a knowledge of the characteristics of the aperture and base.

The *Cerithium georgianum* Lyell and Sowerby was described from this locality, and at first I thought this species might be identical with it, but on further study this seemed unlikely, as the sculpture of the two forms differs. The upper layer in which *C. platynema* was found seemed to differ from the other rocks by the absence of characteristic Eocene types, and the suspicion was awakened in the minds of both Prof. Clark and myself that this upper layer might be part of the earliest Miocene deposited upon the older Eocene formation, though the fauna was not sufficiently abundant or characteristic to decide. Lyell referred the whole to the Eocene.

Cerithium sp. indet.

With the preceding, at Jacksonboro', Scriven Co., Georgia.

Another species with well-defined sculpture is indicated by gutta-percha casts from the same block as that which contained *C. platynema.* It is characterized by about ten narrow, sharply defined, slanting ribs, rounded, with about equal interspaces and extending across the flattened surface of the whorl from suture to suture. Over these are carried three flattened, broad, little-elevated, strap-like spirals with narrower, channelled interspaces. There are no nodulations at the intersections. Behind the suture is a smaller spiral on which the whorl is laid. It is probable that there may be some fine spiral striation on the shell, but the cast shows hardly any indication of it. The cast represents probably the middle third of the spire; one of the whorls in it is 4 mm. axially and 8.5 mm. in diameter. The whorls are as flat-sided as those of a *Vertagus*, but the sculpture is more like that of *Batillaria*. It is impossible to determine to what section of the genus it belongs, but it is evidently distinct from any of the others described in this paper.

Cerithium floridanum Mörch.

Plate 14, figure 10.

C. floridanum Mörch, Mal. Blätt. xxiii. p. 114, 1876.

Pliocene of the Caloosahatchie beds, Dall and Willcox. Living on the east coast of the United States from Cape Hatteras, North Carolina, to the north shore of Cuba, in moderate depths.

This fine species has never been figured. The specimen selected for figuring has not the outer lip and pillar as thick and the subsutural callus as marked as in fully adult examples, but otherwise is characteristic. Its nearest relative is, perhaps, *C. algicola* C. B. Adams.

Cerithium algicola C. B. Adams.

C. algicola Adams, Proc. Bost. Soc. Nat. Hist. ii. p. 5, 1848.

Older Miocene of Bowden, Jamaica, Bland; Pliocene of Costa Rica, Gabb, of the Caloosahatchie beds, Heilprin, and of Shell Creek, Willcox; living on the west coast of Florida from Charlotte Harbor south to Cuba, the Bahamas and Jamaica, between tides.

This species is usually sent out under the name of *atratum*. The genuine *atratum* is easily discriminated. The specimens have been compared with an authentic specimen received from Prof. Adams. It has not been adequately figured; the specimen illustrated in Sowerby's Thesaurus, copied into Tryon's manual, is obviously a dwarf, or has been reduced to about half natural size.

Cerithium callisoma n. s.

Plate 14, figure 8.

Pliocene of the Caloosahatchie beds, Dall.

Shell small, acute, specimen decollate, but showing nine rounded whorls, crossed by seven rounded, rather prominent ribs, which reach the suture in front, but fade out before the suture behind, and are absent on the last half of the last whorl; these ribs are crossed by numerous alternated threads of three sizes, of which two on the periphery and four on the base are most prominent; the base is not excavated, but the threads on the base are nodulous, with deep interspaces, the posterior basal spiral is covered by the suture; the spirals behind this are plain, the two on the periphery slightly swollen where they override the ribs and on the last half of the last whorl; there are no varices except the ribs; suture appressed, not conspicuous;

aperture short, outer lip thickened, with a well-marked sinus at the junction with the body; subsutural ridge strong, body-callus well marked; canal short, recurved, pillar with spiral threads outside, within arched, simple; outer lip grooved near the edge in harmony with the sculpture. Lon. of (decollate) shell 24; max. diam. 7.5 mm.

This species is much like *C. muscarum* Say, but is readily distinguished by the basal sculpture, and the absence in *C. callisoma* of the excavation which is so marked a feature of *C. muscarum*.

Cerithium muscarum Say.

C. muscarum Say, Am. Conch. v. pl. 49, fig. 1, 1832; Tryon, Man. ix. p. 132, pl. 23, figs. 12, 13.

C. notatum Menke, Synopsis, p. 33, 1826, ed. ii. p. 58, 1830 (name only).

Pliocene of the Caloosahatchie, Myakka and Alligator Creek, Florida, Willcox and Dall; Post-Pliocene of North Creek, Little Sarasota Bay, Florida, Dall; living on the coasts of Florida from Lake Worth on the east and St. Andrew's Bay on the west south to Cuba and Jamaica.

This fine species is readily recognizable by its prominent sculpture and deeply excavated base. Menke, who seems to have received specimens labelled "*stercus-muscarum* Say," a specific name already in use, suggested the name *notatum* for the species, but did not describe it, and when Say some years afterward published a description he named it *muscarum*.

Cerithium glaphyrea n. s.

Plate 14, figure 4.

Pliocene of the Caloosahatchie, Dall.

Shell small, with two or three smooth nuclear and ten subsequent well-rounded whorls; spiral sculpture of numerous stout, flattened, close-set threads, varying somewhat in size, of which a pair in front of the suture and one near the periphery are nodulous, while the rest are merely wavy or transversely wrinkled, if not simple; some, though not wider, are more elevated than others; suture distinct, not appressed or marginate; transverse sculpture of about fifteen small, feeble ribs, which are made evident by the nodulation of the three principal spirals before mentioned where the latter override them, and one or two not prominent varices, of which one will be on the last whorl; aperture expanded slightly, outer lip thickened and faintly grooved in harmony with the exterior sculpture, a moderate callus and subsutural ridge on the body; pillar simple, short, twisted; canal short, well marked, recurved; base rounded, spirally threaded, not excavated. Lon. of figured specimen 16; max. diam. 6 mm.

Cerithium glaphyrea var. litharium Dall.

Plate 14, figure 9.

Pliocene of the Caloosahatchie, Shell Creek and Alligator Creek, Dall and Willcox.

This differs from the type by its more prominent and nodular sculpture and somewhat larger size. The variety has two prominently nodulous bands in front of the suture, then a beaded secondary spiral, then another nodulous primary followed by four or five secondaries, including all the basal spirals, which are regularly beaded. The suture is coiled on the posterior of these last, but does not cover it, so the variety has the suture marked by a beaded line behind it. Lon. of figured specimen 19.0; max. diam. 6.5 mm.

This species and its variety are of the group to which *C. muscarum* Say belongs, but have not the excavated base of that species.

Cerithium coccodes n. s.

Plate 22, figure 6.

Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox.

Shell acute, with the nucleus decollate and twelve or more subsequent moderately rounded whorls; varices numerous, about twenty-two in all, distinct, but not very prominent; spiral sculpture of, on the upper whorls, three principal, not-much-elevated, beaded primaries, separated by wider interspaces in which run three simple or somewhat wavy secondary threads, of which the middle one is a little more prominent than the other two. On the last whorl we have the beaded thread next the suture more prominent than the others; in some specimens the beads become pointed, almost spinose; in front of this is a smaller, sometimes wavy, elevated line, then three more beaded lines with the intercalary plain threads, then on the base two to four smaller beaded lines and numerous finer threads; on the upper part of the spire between the varices are small, narrow transverse riblets under the beads, three in each intervarical space, but on the later whorls, except the varices, there is no transverse sculpture; aperture short, ovate, a well-marked callus and subsutural ridge on the body; outer lip moderately thickened, faintly striated within in harmony with the sculpture; pillar simple, short, arched; canal short, recurved. Lon. of shell 31; max. diam. 9 mm.

This species is quite recognizable by its fine, rather sharp, granular sculpture, with no transverse ribbing on the greater portion, and its numerous but not prominent varices. There is no recent species on our coast which is nearly related to it.

Cerithium præcursor Heilprin.

Cerithium præcursor Hp., Trans. Wagner Inst. i. p. 114, pl. 16, fig. 58, 1887.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa, Florida, Heilprin, Dall and Crosby.

This species has on each of the later whorls four prominent, flattish primaries separated by wider, channelled interspaces, each containing two or three very fine spiral threads. On the anterior primary the suture is wound. The base and canal have four primaries, usually, with intercalary threads. The aperture is narrower than in most of the preceding species, the pillar simple. When perfect the sculpture is pretty sharp. The species seems to be a precursor of such forms as *C. glaphyrea* var. *litharium* and *C. muscarum.*

Cerithium chipolanum n. s.

Plate 22, figure 7.

Older Miocene of the Chipola beds, N. W. Florida, Burns.

Shell of the general type of *C. thomasiæ* Sowerby, but small, with three very small, smooth, compact nuclear whorls and eight subsequent rounded whorls; transverse sculpture of numerous small, rounded ribs extending across the whorl, and which are relatively stronger and more irregular, though less numerous, on the early whorls; the varices are quite irregular, some being strongly marked and others feeble; spiral sculpture of three or four primary, little-elevated, flattish threads, separated by wider interspaces, in which are two to four fine secondary threads; there are no beads or nodules, but the primaries appear conspicuous where they cross the ribs; similar sculpture extends over the base; aperture not much expanded, with a moderate callus and subsutural ridge on the body, a short, recurved canal and arched pillar. Lon. of shell 10; max. diam. 4.5 mm.

This curious little species sometimes has a flattened aspect like a *Ranella,* from the tendency of the varices to be confined to one side. It is not closely related to any of the preceding forms.

Cerithium sp. indet.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Dall.

Two specimens in too poor condition to describe, but apparently different from any other known from the strata of that locality and region, were found by the writer at the silex-bed at Ballast Point.

Cerithium vinctum Whitfield.

Plate 22, figure 9.

C. vinctum Whitfield, Am. Journ. of Conch. i. p. 265, pl. 27, fig. 8, 1865.

Newer Eocene of Vicksburg, Miss., Whitfield; nine miles southeast of Jewett, Leon County, Texas, J. A. Singley in Coll. Aldrich.

This interesting species has never been figured in the mature state, and, by the courtesy of Mr. Aldrich in lending a specimen which preserves the aperture, I have been able to supply the deficiency. Some doubt has been cast upon the generic place of this species, which this illustration will remove. It has been supposed that *Rostellaria Whitfieldi* Heilprin (Proc. Acad. Nat Sci. Phila. for 1879, p. 216, pl. xiii. fig. 14) was the adult form of *C. vinctum*. An inspection of a specimen of *R. Whitfieldi* in the National Museum shows, however, that this is not the case; but the last-mentioned species is probably a *Cerithium* of the same group as *C. vinctum*, but growing to a much larger size.

A few other species of large Cerites are known from the American Eocene; one from Prairie Creek and another from Red Bluff are about to be described by Mr. Aldrich. *C. texanum* Heilprin,* described from a fragment, is probably not a Cerite; it has more the appearance of a gigantic Melanian, like some of the East Indian forms. A much better specimen than Heilprin's was collected by Singley near Wheelock, Texas. This shows that the spire is not so rapidly tapered and short as supposed by the describer. The pillar is arched and simple as in *Goniobasis*, with no trace of the spiral ridges which appear in the giant Cerites of the Parisian Eocene.

Genus **POTAMIDES** Auct.

The whole synonymy of the Cerites is in great need of revision. This genus is usually ascribed to Brongniart, but I have not found any evidence that he used anything but a French name for the group. There is no doubt that Lamarck, Link and others used the name *Cerithium* for the group sometimes called *Vertagus*; Lamarck's sole type in 1799 was *Murex aluco* Linné, which is also the type of *Vertagus*. *Pyrazus* of Montfort was not founded on the species *palustris*, as his figure shows; though he confounded his *P. Baudini* with the *Strombus palustris* of Linné. But it is not practicable to review the synonymy at this time, and I shall not attempt it, but shall adopt the names in common use, although most of them may eventually have to be changed when a rigid application of the rules of biological nomenclature is made to the group.

Potamides hillsboroënsis Heilprin.

Plate 15, figure 12.

Cerithium hillsboroensis Heilp., Trans. Wagn. Inst. i. p. 124, pl. 8, fig. 67, 1887.

Older Miocene of the Orbitolite bed at Tampa, Willcox, Dall; and at Chattahoochee, Burns.

This species is found in the lower or older Miocene (Tampa limestone) rocks of the Hillsborough River, and of the Ocheesee group in Northwestern Florida. The original figure was very bad and I have had the type redrawn from a gutta-percha cast of the original mold. It has so far only been found in the shape of molds in the lime rock. The new figure is sufficiently clear, and it need only be added that all the specimens examined appear to have been decollated in life. The tubercles on the posterior spiral are sometimes very prominent, almost spinose, and the other spirals may all be tuberculous. Toward the aperture they become more prominent than on any other part of the shell, contrary to the usual rule. The base is discoid, with three small spiral, elevated lines. The canal is deep and truncate, the suture sometimes channelled and sometimes appressed. The length of the type-specimen is 31 and its breadth 15 mm.

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* Proc. Acad. Nat. Sci. Phila. for 1890, p. 404, pl. xi. fig. 2.

Subgenus **Lampanella** Mörch.

Potamides (Lampanella) transecta Dall.

Plate 11, figure 7.

Potamides (*Lampanella*) *transecta* Dall, Trans. Wagn. Inst. iii. p. 189, pl. 11, fig. 7, 1890.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida.

Shell with an extremely acute tip, which is usually lost, two or three minute, smooth nuclear whorls and about twelve subsequent sharply sculptured whorls; spiral sculpture, between the distinct but not channelled sutures, of four sub-equal strap-like spirals separated by nearly equal channelled interspaces, overriding seventeen or eighteen narrow, rounded, somewhat flexuous transverse riblets which cross the whorls; the intersections are prominent, but not nodulous, the base is similarly sculptured without riblets; on the later whorls smaller intercalary spiral lines begin to appear; there is a single varix at the end of the first half of the last whorl, but it is not very prominent; the pillar is short and simple, the canal truncate, well defined; the outer lip is slightly thickened, expanded and internally grooved in harmony with the sculpture; the body has a small subsutural ridge and a thin, reflected callus. Lon. of figured specimen 17.5; max. diam. 8.5 mm.

This neat little species seems not uncommon in the silex-beds.

Other species of *Potamides* in our Tertiary are the Eocene *P. alabamiensis* Whitfield, from Bell's Landing, Alabama, and *P.* (*Cerithium*) *tombigbeënsis* Aldrich, from Wood's Bluff, of which I have examined typical specimens.

Subgenus **Pyrazisinus** Heilprin.

Pyrazisinus Hp., Trans. Wagner Inst. i. p. 115, 1887.

This group is intermediate between *Cerithidea* and *Potamides*. In its effuse thickened outer lip with a wide posterior sinus it resembles the former and also *Pyrazus ebeninus*, but in its truncate large canal it recalls *Potamides*. The habit of the shell is like that of some *Cerithideas*, yet some of the species of *Potamides* are also similar. In short, this is one of the links constantly turning up which unite the different groups into which the great army of Cerites has been divided.

Potamides (Pyrazisinus) campanulatus Heilprin.

Plate 11, figures 10, 10 a; plate 15, figures 2, 6, 10.

Potamides (*Pyrazisinus*) *companulatus* Heilp., Trans. Wagn. Inst. i. p. 115, pl. 16, fig. 59, 1887.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Willcox, Shepard, Dall and Burns; also at Bailey's Mill Creek sink, three-quarters of a mile northeast of Lloyds, Jefferson Co., Florida, in a residual clay, L. C. Johnson.

This species varies very much in adult size, and also in the strength of its transverse sculpture; at the junction of the outer lip with the body it is prolonged upward, callosified and faintly grooved in the middle of the callus, in fully mature specimens. The principal varix is at the end of the first half of the last whorl, and it is often very prominent. The spiral grooving tends to be strongest in front of the suture. I have seen no specimens with transverse ribs as square and prominent as in *P. cornutus* or *P. scalatus.*

Potamides (Pyrazisinus) cornutus Heilprin.

Plate 15, figure 3.

Cerithium cornutum Heilp., Trans. Wagn. Inst. i. p. 124, pl. 8, fig. 68, 1887.

Older Miocene on the Pithlachascootie River, Florida, Willcox; Orthaulax bed at Ballast Point, Tampa Bay, Florida, rare, Dall; also in the form of molds in the Orbitolite bed, or Tampa limestone, near Tampa City, overlying the Orthaulax bed, Dall.

Only one specimen of this species was obtained by Mr. Willcox, and that is in a very imperfect condition. I removed it from the limestone in which it was partially imbedded, and it proves to belong to the same group as *P. campanulatus.* A new figure has been made of the type-specimen. This specimen, after forming its outer lip, during life suffered a fracture, and, as is often the way in such cases, formed a second lip, somewhat abnormal in form. In the figure, *b* shows the posterior extreme of the original normal lip, while *a* is the fractured end of part of the second lip, or " horn " of Heilprin's description. The specimen is a much-worn siliceous pseudomorph with much of the last whorl destroyed. The specimens from Ballast Point show about ten oblique, strong transverse ribs, with the whorl behind constricted between them and the suture; the spiral grooving extends to the suture as in *P. scalatus.* The varix is extremely prominent. The shell, from the scant material obtained, seems intermediate between *P. campanulatus* and *P. scalatus.* The molds in the Tampa limestone afforded some barely recognizable casts in gutta-percha.

Potamides (Pyrazisinus) scalatus Heilprin.

Plate 15, figures 1, 4, 7, 8, 10 b.

Cerithidea scalata Heilprin, Trans. Wagn. Inst. i. p. 132, pl. 16 b, fig. 71, 1887.

Pliocene of the Caloosahatchie beds, Myakka River and Shell Creek, Florida, Willcox and Dall; also off Stump Pass, thrown up on the beach by the sea from submarine Pliocene beds.

In the typical form (fig. 1) the transverse ribbing is strong and the spiral grooving is faint or absent behind the ribs; the varix is less prominent than in *P. cornutus* and *P. campanulatus*. The way in which the lower lip grows round so as finally to enclose the canal is shown in figures 7 and 8. The posterior end of the outer lip is extended backward and grooved sometimes, as in *P. campanulatus*, though not shown in the specimen figured. In the variety *ecarinatus* (fig. 4) the transverse sculpture is absent or reduced to faint ripples, as in many specimens of *P. campanulatus*, the varix is feeble, and the spiral grooving continuous back to the suture.

The appearance of these three forms suggests that with sufficient material they might be so connected as to form merely subordinate races of one species. The differences observed are not greater than exist among Cerites now living which are obviously of one and the same species and, perhaps, progeny of one pair of specimens.

Potamides (Pyrazisinus) acutus n. s.

Plate 22, figure 19.

Older Miocene of the Tampa limestone on the Hillsborough River above Tampa, Florida, Dall.

Shell stout, with an acute spire and ten or more convex whorls; suture distinct, not deep; nuclear whorls about three in number, smooth, subsequent whorls finely spirally striate; transverse sculpture of twelve or more little-elevated, sharpish ribs with much wider interspaces, most prominent near the periphery and obsolete toward the sutures; lines of growth flexuous, not prominent; last half of the last whorl beginning with a strong varix; aperture large, pillar short, stout, outer lip exhibiting a prominent callosity where it is attached to the body, then receding, then patulous and projecting in front, then sweeping round much prolonged until it touches or nearly touches the varix; inside of the lip smooth or obscurely striated. Alt. 40; max. diam. about 23 mm.

This remarkable form occurred as a mold in the soft limestone of the Hillsborough River. By sacrificing this mold a tolerable cast of the shell in gutta-percha was secured, from which the drawing was prepared. It is readily distinguished from the other species of this group by its acute spire and the prolonged sweep of the outer lip.

Genus **CERITHIDEA** Swainson.

Cerithidea turrita Stearns.

Cerithidea turrita Stearns, Proc. Bost. Soc. N. Hist. xv. p. 24, 1872.

Pliocene of Shell Creek, Florida, Willcox; living on the west coast of Florida and the Bahamas.

It is somewhat singular that this little species should be the only one of the group yet found in the Floridian Pliocene. It is probable that the place now occupied in the economy of Nature by *Cerithidea* on the shores of Florida was in those older days filled by the now extinct *Pyrazisinus.*

The type-specimen of *Cerithidea minuta* Gabb, from the Miocene of Santo Domingo (Geol. Rep. St. Domingo, p. 239, 1873), is a species of *Rissoina.*

Genus **CLAVA** Martyn.

= *Clava* Martyn, Univ. Conch., Table, 1789; +*Cerithium* Lamarck, 1799; +*Vertagus* Schumacher, 1817; +*Rhinoclavis* Swainson, 1840.
= *Cerithium* Bruguière, Enc. Méth. 1789, *ex parte.*

By adopting Martyn's name (the first of his two species being a *Vertagus*) we can retain *Cerithium* Bruguière for the mass of the Cerites without violating the rules of nomenclature.

Clava plebeia Sowerby.

Cerithium plebeium Sby., Quart. Journ. Geol. Soc. vi. p. 51, 1850; Guppy, Proc. Geol. Soc. Lond. xxii., pt. i. p. 290, pl. xvi. fig. 9, 1866.

Miocene of Santo Domingo and Jamaica, Heniker and Guppy.

This fine species is of the type found in the Southern Tertiary of the United States, but is larger and has a proportionately larger last whorl than any of our species.

Clava chipolana n. s.

Plate 22, figure 8.

Older Miocene of the Chipola beds, Northwest Florida, Burns.

Shell small for the genus, with two extremely minute, smooth nuclear whorls and thirteen to fifteen subsequent sculptured whorls; the tip of the spire is very acute, from about the seventh whorl it is enlarged more rapidly in proportion; the early whorls have about seven sharply elevated narrow ribs, extending across the whorls, with wider interspaces, over which run three strap-like spirals with about equal channelled interspaces, prominent but not nodulous at the intersections; the ribs gradually get more numerous and close-set, so that the reticulations are about square, and between the spirals a small intercalary thread appears which becomes wavy on the last whorl; the varix occurs at the end of the first third of the last whorl, and beyond it the ribs are obsolete; the last whorl has six prominent and as many intercalary spirals behind the base, which has three or four somewhat smaller rippled primaries and an equal number of intercalary simple threads; outer lip thickened, not reflected, slightly sulcate in harmony with the external spirals; body with a well-marked subsutural ridge and notch outside of it, and with a moderate callus; pillar short, with a thick, elevated callus and a strong plait about the middle; canal short, reflected; varix swollen, not very prominent; suture appressed, distinct. Lon. of shell 22; max. diam. 7.5 mm.

This is a well-marked little species with much such a sculpture as *Lampanella transecta* Dall, but immediately recognizable by the plait on the pillar.

Clava caloosaënsis n. s.

Plate 14, figure 3 a.

Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox.

Shell acute, nucleus wanting, remainder exhibiting two smooth minute and fifteen gradually enlarging sculptured whorls; the earlier whorls show four small revolving spirals with the anterior pair larger and no transverse ribs; the peripheral thread soon shows nodulations, and several fine threads appear on each side of it; later the sculpture resolves itself into three flattened spirals with equal channelled interspaces minutely undulated, at first with regularity, afterward with more or less irregularity, the points of the waves nodulous and the spirals keeled on their posterior edges and bevelled anteriorly; gradually the antesutural band becomes more prominent, wider and more strongly nodulous than the others, which are alternated in size and amount to four beside that on which the suture is wound; on the last whorl, in front of the sutural nodulous band, there are ten elevated spirals, becoming less alternate in size and feebler anteriorly; the canal and the base about it are free from spiral sculpture or show it very faintly; the transverse sculpture is not regular enough to be termed ribs anywhere on the shell, and is chiefly limited to the nodular undulations of the spirals and a swollen varix at the end of the first third of the last whorl; the surface when perfect is brightly polished; the suture is distinguished by its nodulous band; the spire increases regularly; the outer lip is thickened, swollen, and shows a deep sinus at the junction with the body, where there is no distinct subsutural lamina; it is feebly grooved inside; the body is callous and a broad callus is reflected over the pillar; the canal is small, narrow and sharply recurved. Lon. of shell 27; max. diam. 8.5 mm.

This species resembles *C. chipolana*, but may be distinguished by the different sculpture and less attenuation of the early whorls, the absence of distinct ribbing and generally less prominent sculpture, and the presence of a predominant spiral band in front of the suture.

There is an indeterminate species of *Clava* in the Miocene of Bowden, Jamaica, but the genus has been supposed to be absent from the Antilles. There is, however, in the collection of the National Museum a broken specimen of a recent species of *Clava*, resembling *C. Kochii* Phil., which was collected in 1864 at Barbados by Lieut. G. L. Fitzgerald, R. N., so that it is possible that further exploration may reveal one or more species of the group still living in the Antilles. It would be a singular fact if a genus which persisted from the Miocene to the Pliocene in the immediate vicinity, in company with many other forms still living, and which in its habits has nothing peculiar or exceptional, should suddenly drop out of the fauna, while its neighbors and near relatives were able to maintain their position without difficulty.

FAMILY PLEUROCERATIDÆ.

Genus **GONIOBASIS** Lea.

Goniobasis sp. indet.

A single specimen of a beautifully sculptured *Goniobasis*, resembling in a general way, as nearly as I can recall it, *G. Hallenbeckii* Lea, was collected by Mr. Willcox on the Caloosahatchie. Unfortunately, in packing for transportation to Washington this specimen was mislaid, and has not yet turned up, so that the presence of the genus in the Caloosahatchie marls is all that can be certified to at the present moment.

FAMILY LITIOPIDÆ.

Genus **ALABA** A. Adams.

There are several species of this group in the Tertiary of America, generally masquerading under other names: *Cerithium moenensis* Gabb, from the Miocene of Santo Domingo and the Pliocene of Costa Rica, is an *Alaba* much like *A. tervaricosa* Adams, and the same may be said of *Rissoina plicatovaricosa* Heilprin (Proc. Ac. Nat. Sci. 1879, p. 214, pl. 13, fig. 12) from the Claibornian.

It may be noted that *Litiopa* occurs in the American Tertiary as early as the Eocene. *Cerithioderma spirata* Meyer, from the Eocene of Jackson, Miss., is a well-characterized *Litiopa*. It was described in the Ber. Senckenburgische Naturf. Ges. für 1887, p. 8, pl. 1, fig. 7, and I have been able to examine the type-specimen.

Alaba chipolana n. s.

Plate 21, figure 9.

Older Miocene of the Chipola beds, Northwest Florida, Frank Burns.

Shell small, smooth, with two very minute nuclear and eight or nine subsequent well-rounded whorls; sculpture only of faint incremental lines, obscure malleations and faint varices; the varices are irregular in number, sometimes as many as three on one whorl, but they are little elevated; the penultimate varix is usually more pronounced in the adult than any of the others; aperture sub-ovate, outer lip slightly thickened inside, simple; basal part rounded, with a faint sinus at the end of the pillar; body without perceptible callus; pillar straight, slender, perceptibly axially twisted. Lon. of shell 6.0; max. diam. 2.75 mm.

This species is smoother than most of the genus, but has the characteristic features of *Alaba*.

FAMILY TRICHOTROPIDÆ.

Genus **TRICHOTROPIS** Sowerby.

Subgenus **Cerithioderma** Conrad.

Cerithioderma Conrad, Journ. Acad. Nat. Sci. Phila., 2d Ser. iv. p. 295, March, 1860. Type and only species *C. prima* Conr., *op. cit.* p. 295, pl. xlvii. fig. 30. Eocene, Alabama.

Mesostoma Deshayes, An. s. vert. bas. de Paris, t. 2, p. 416, 1861; 1st species *M. pulchra* Desh., *op. cit.* p. 416, pl. 28, figs. 13-16. Parisian Eocene.

I have satisfied myself by an examination of Conrad's type that his *Cerithioderma* is identical with *Mesostoma*. Deshayes's manuscript in my possession indicates that the sheets containing that genus were printed in 1861; Conrad's name, therefore, has priority, and must be adopted.

Cerithioderma prima Conrad.

C. prima Conr. *supra vid.*

Mesostoma rugosa Heilprin, Proc. Acad. Nat. Sci. Phila. 1879, p. 215, pl. xiii. fig. 13; Meyer, Ber. Senckenb. Ges. 1887, p. 18.

Mesostoma Lisbonensis Aldrich, MS. Eocene of Lisbon, Ala.

Middle and Upper Eocene of Claiborne and Lisbon, Ala.; older Miocene of the Orthaulax bed, Tampa, Florida?

The specimen from Ballast Point is in such a poor condition that it is quite possible this provisional identification will not be confirmed. The specimen from Lisbon is heavier and larger than most of those from Claiborne, and has fewer and stouter ribs on the last two whorls, but I think it is merely an individual mutation of *C. prima*. *C. rugosa* Heilprin does not appear to differ materially from *C. prima*. I have examined the types. The nucleus of *Cerithioderma* is smooth, the first whorl and a half small, nearly flat above; the next whorl much larger, polished and inflated.

I have described a recent species, *C. migrans*, from eighty fathoms off Havana, Cuba, which is very similar to the fossil form. As already noted, *C. spirata* O. Meyer is a *Litiopa*.

The genus is represented by several species in the Paris basin.

FAMILY MODULIDÆ.

Genus **MODULUS** Gray.

Modulus Gray, Synopsis Brit. Mus. 1842, pp. 60, 90 (name only); P. Z. S. 1847, p. 150.

Turbinopsis Conrad, Journ. Acad, Nat. Sci. Phila., 2d Ser. iv. p. 289, Feb.-Mar., 1860. Type *T. Hilgardi* Conr., Cret. Miss.

Pseudotrochus Heilprin, Trans. Wagner Inst. i. p. 114, 1887. Not of Klein.

There are two species in the Cretaceous greensand of New Jersey, one of which has been described by Professor Whitfield in his manuscript report on the mollusks of this formation. The other was supposed by Conrad to be identical with his *Turbinopsis Hilgardi.* This form differs from the ordinary *Modulus* in having a deep, wide umbilicus; but, since the recent species of *Modulus* may be either imperforate or umbilicated, this is not a character of great weight. The type of *Pseudotrochus* Heilprin is a typical and remarkably fine species of *Modulus.* In most of the manuals *Modulus* is given merely as a recent genus, but it has existed in America continuously since the Cretaceous. *Monodonta basilea* Guppy, from the older Miocene of Jamaica (Geol. Mag. Dec. ii., vol. i. p. 442, pl. xvi. fig. 2, 1874), is a typical *Modulus.*

Modulus turbinatus Heilprin.

Plate 18, figure 12.

Pseudotrochus turbinatus Heilprin, Trans. Wagner Inst. i. p. 114, pl. 16, fig. 57, 1887.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Willcox, Dall and Crosby.

This fine species has been refigured, as the original figure was far from satisfactory.

Modulus Willcoxii n. s.

Plate 18, figure 1 a.

Older Miocene of the Chipola beds, Northwest Florida, Burns.

Shell large, strong, with two (or more) small, smooth nuclear and seven subsequent sculptured whorls; whorls with a blunt duplex carina, on which the suture is wound; spiral sculpture, above the carina, of five or six strong, rather sharp, elevated ribs, subequal, with about equal interspaces; below the carina, on the base, are about seven more, growing stronger and flatter toward the pillar; these spirals are undulated by the intersection of numerous transverse sulci in harmony with the lines of growth; base flattish, subconic; aperture subquadrate; outer lip sharp-edged, sharply lirate inside in harmony with the spiral sculpture; body with a thin callus; pillar short, bearing a broad and strong revolving lamella; umbilicus closed; suture distinct, slightly turriculate. Alt. of shell 20; max. diam. 14 mm.

Mr. Burns obtained but a single specimen of this fine species, which it gives me much pleasure to dedicate to Mr. Joseph Willcox, to whose energy and interest this investigation of our Southern Tertiary is largely due.

Modulus compactus n. s.

Plate 22, figure 10.

Older Miocene of the lower bed at Alum Bluff, Chattahoochee River, Florida, Burns.

Shell small, turbinate, with a rather pointed apex and about six whorls (nucleus lost), rapidly enlarging; transverse sculpture of ten rounded ribs extending from the suture to the periphery, where they cease abruptly, the interspaces wider than the ribs; lines of growth well marked; spiral sculpture of (on the last whorl seven above and seven below the periphery) strong equal rounded threads with wider regular interspaces in which run minute spiral striæ; whorls full, subangulate at the periphery, the base slightly flattened; suture distinct; umbilicus pervious, bounded by a rather wide smooth fasciole; aperture subquadrate, sharply lirate inside; a thin callus on the body; pillar thin, short, with a broad, sharp, nearly horizontal tooth at the base. Alt. 9.0; max. diam. 8.0 mm.

A single specimen of this well-marked little species was obtained. It has the same pointed spire as the other Chipola species, but differs from them and from the other American species in the details of its sculpture.

Modulus floridanus Conrad.

Modulus floridanus Conr., Am. Jour. Conch. v. p. 107, pl. 12, fig. 6, 1870.
Modulus corrugatus Stimpson MS.
Modulus Krebsii Mörch, Mal. Bl. xxiii. p. 129, 1876.

Pliocene of the Caloosahatchie beds, Dall and Willcox; Post-Pliocene of North Creek, Florida, Willcox; living on the west coast of Florida, the Keys, and in the Antilles, and northward twenty-five to thirty-five miles off shore to the latitude of Hatteras, North Carolina; also at Bermuda.

Modulus modulus Linné.

Trochus modulus Linné, Syst. Nat., Ed. x. p. 757, 1758.
Trochus filosus Helb. + *T. tectum* Gmelin, + *T. perlatus* Dillw., + *T. unidens* Mörch; *Monodonta carchedonius* Lam., + *Modulus canaliculatus* Beck, + *M. lenticularis* Auct.

Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox; living from the west coast of Florida south to the Brazilian coast between tides.

This ancient, well-known and extremely variable species, of which *M. floridanus* is merely a race, is rather rare in the marls and seldom attains the maximum size of recent specimens.

FAMILY CÆCIDÆ.

The singular mollusks of this family have been monographed by Carpenter and their classification reviewed by De Folin (Bayonne, 1875), who has also printed a catalogue of the species. Owing to the remarkably different aspect these forms assume at different stages of growth in the same individual, they are particularly well adapted to lead the unwary into error. In the American Tertiary they extend from Mid-Eocene to the present epoch. The group comprises five genera—*Cæcum* Fleming (1817), *Meioceras* and *Strebloceras* Cpr. (1858), *Parastrophia* De Folin (1869), and *Watsonia* De Folin (1879).

In *Cæcum* the shell begins as a planorbiform nucleus, resembling a minute *Adeorbis*, which is coiled symmetrically like a nautilus shell, from which the whorl extends as a gently arched tube. After a time this tube enlarges sufficiently to contain all the soft parts, and they are moved forward into the newer portion, which is then separated from the shell of the first stage by the formation of a "plug" or "septum" which entirely separates the cavity into two parts, shortly after which the vacated portion drops off and is lost, though in rare instances it is retained abnormally. The shell of the second stage has only traces of the adult sculpture, annulate species may be nearly smooth when in the second stage, etc., and when the second stage is complete the beginning of the third stage, which continues straight with a dorsal arch, is usually marked by a sudden and considerable increase in the diameter of the tube. The animal now assumes its adult characteristics, grows steadily until the shell of the third stage contains the whole of the soft parts, a new plug is then formed and the empty secondary shell is dropped in its turn. The creature has a multi-spiral horny operculum, and the external form of the plug, rounded, pointed or with a spurlike projecting process, is characteristic for the species. The external surface of the shell may be smooth, longitudinally sulcate, annulate or reticulated, and is sometimes even spinose. The recent shell is usually brownish, white, or mottled yellow and white.

The genus *Strebloceras* differs from *Cæcum* by the asymmetry of its planorboid nucleus and the fact that instead of being dropped it is retained through life, no septa being formed. The group is chiefly fossil and indicates the formative period of the *Cæcidæ*, when the habit of dropping the early stages had not become fixed. It is questionable whether the only recent species is not founded on an abnormal atavistic individual of the typical genus.

The genus *Parastrophia* has a small, loosely coiled nucleus of a single whorl; where this is dropped the posterior end is sealed by a secretion of shelly matter, no plug is formed and the shell continues to grow as a slightly sigmoid, rapidly enlarging cone. In this type there are only these two stages. *Watsonia* is quite similar in a general way, but shorter, more inflated and with a singularly oblique orifice.

Meioceras begins like *Cæcum*, but the second stage is shaped like a cow's horn, rapidly enlarging; the third stage is still more different, short, mostly smooth and equatorially tumid and but little arched. These stages are remarkably different, and it is not very surprising that O. Meyer described the second stage of this genus as a Pteropod, under the name of *Bovicornu*, although it had been figured and described by De Folin eleven years previously.

In studying the American species of this difficult group, I have had the kind assistance of the Marquis Leopold de Folin, who has examined specimens of all the species here mentioned, aided by his unrivalled collection of specimens of this genus.

Genus CÆCUM Fleming.

Comparatively few species of this genus have been described from the American Tertiary.

In the Miocene we have *C. virginianum* Meyer and *C. Stevensoni* Meyer, from Yorktown, Va. (Proc. Am. Phil. Soc. xxv., No. 127, p. 139, figs. 3 and 4, 1888). Specimens collected at Yorktown by Mr. Harris indicate that these two species are valid. *C. annulatum* Emmons (*non* Brown), from the Newer Miocene of North Carolina, is *C. floridanum* Stimpson; *C. annulatum* Gabb (Geol. St. Domingo, 1873, p. 241; Journ. Acad. Nat. Sci., 2d Series, viii. p. 363, pl. 46, fig. 59, 1874), *non* Brown *nec* Emmons, appears to be a good species, but the figured type seems to be the second stage of what in the adult condition Gabb has named and figured (*op. cit.* f. 58) as *C. crassicostum*, which name, as *annulatum* is preoccupied, may be kept for the species. The original form came from the Miocene of Santo Domingo and the adult from the Pliocene of Costa Rica. We have no very similar species in the Tertiary of the United States, though a not quite adult *C. floridanum* would approach it. *C. constrictum* Gabb (Geol. St. Domingo, p. 241, 1873) is with little doubt identical with *Meioceras nitidum* Stm. The other species known from the American Tertiary will be found referred to below.

Cæcum solitarium Meyer.

C. solitarium Meyer, Ala. Geol. Rep., p. 68, pl. iii. fig. 9, 1886.
? *C. alterum* Meyer, Ber. Senck. Nat. Ges. 1886, p. 6, pl. i. fig. 8.

Eocene of Vicksburg, Miss., Meyer; Orthaulax bed at Ballast Point, Tampa Bay, one specimen, Dall.

C. solitarium is described as smooth except for incremental lines, and figured as 2 mm. long. A typical specimen named by Meyer is 2.6 mm. long and is in the second stage of growth. The enlarged beginning of the third stage is present and shows distinct but not prominent annulæ; in the adult condition this species is doubtless one of the annulate forms. The specimen from the silex-beds is too imperfect to be positive, but looks as if it might be an incomplete example of the second stage of the same shell.

The plug is bluntly conical, with the apex nearest the right side of the posterior aperture.

C. alterum Meyer, also from the Eocene of Mississippi, at Jackson, may well be the third or adult stage of *C. solitarium*. It is represented as annulate, without any expanded lip, and 2.5 mm. in length. These two forms, if they be more than diverse stages of a single species, are, so far as yet known, the only American Eocene species of the genus.

Cæcum floridanum Stimpson.

C. floridanum Stm., Proc. Bost. Soc. Nat. Hist. iv. p. 112, 1851 (young shell).
C. irregulare De Folin, Journ. de Conchyl. xv. p. 46, pl. 3, fig. 6, 1867 (Bahia).
C. annulatum Emmons (*non* Brown, 1814), Rep. Geol. N. Car., p. 274, fig. 190, 1858.

Newer Miocene of North Carolina, Emmons; Pliocene of the Caloosahatchie, Dall; living in shoal water from North Carolina south to Florida, the Antilles and the northeast coast of South America to Bahia.

This shell in the adult state is recognizable by its large size, numerous annulations (of which a few near the aperture are more distant and much stronger than the rest) and fine longitudinal striæ, noticeable especially between the rings. The plug has a slender mucro, set asymmetrically to the right and projecting from a nearly flat surface.

Cæcum floridanum var. compactum Dall.

Plate 20, figure 9 b.

Newer Miocene of the Cape Fear River, N. C., at Mrs. Purdy's marl-bed, Johnson; Pliocene of the Caloosahatchie, Dall.

This form has the rings more closely set, so that the interspaces except near the mouth are visible merely as fine lines. In the young stages of the shell the annulations are often quite widely separated as described by Stimpson, but they are more close-set in the adult, and in this variety they touch except at the anterior part of the shell.

Cæcum coronellum n. s.

Plate 20, figure 11 a.

Newer Miocene of Cape Fear River, N. C., at Mrs. Purdy's marl-pit, Johnson; Pliocene of the Caloosahatchie, Dall; living on the coast of North Carolina, twenty miles off Cape Hatteras in fifteen fathoms, U. S. Fish Commission.

Shell in the adult stage attaining a rather large size, rather thin, not much tapered, with about twenty-four equal, little-raised, elevated, longitudinal threads, with equal or wider interspaces; transverse sculpture of distinct, wavy lines of growth, stronger near the posterior end; the tube near the adult aperture is suddenly enlarged, forming a stout ring around the aperture; the tube is not constricted behind the ring, and the aperture looks somewhat obliquely downward; margin of the aperture sharp, distinctly crenulated or denticulated by the ends of the longitudinal threads; operculum? posterior end with the margin simple; plug nearly hemispherical, with a very small mucro at the extreme right-hand edge; surface glistening when perfect, the young with a much-flattened plug, with a very slender, rather long mucro, which in the adult is generally worn down. Measurements of two specimens give the length A, 3.75; B, 5.5; max. diam. of aperture, A, 0.9; B, 1.4; diam. of posterior end, B, 1.0 mm.

This elegant little shell is quite distinct from any of the figured species, recent or fossil, with which it has been carefully compared.

Cæcum regulare Carpenter.

C. regulare Cpr., P. Z. S. 1858, p. 16, No. 22.

Pliocene of the Caloosahatchie, Alligator Creek and Shell Creek, Dall and Willcox; living in the Antilles, at Singapore and in Australia. This species was identified by the Marquis de Folin from specimens sent him by Carpenter, and agrees with others named by Carpenter in the National collection. It is much smaller than *C. floridanum*, and has numerous rather distant rings, with a flattish plug having a small, sharp subcentral mucro.

Cæcum Cooperi S. Smith.

C. Cooperi Sanderson Smith, Ann. Lyc. N. Hist. N. Y. vii. pp. 154, 168, 1862; *ibid.* ix. p. 393, fig. 3, 1870; Tryon, Man. viii. p. 221, pl. 67, figs. 84, 85; not of Carpenter.
C. Smithii Cooper, Proc. Acad. Nat. Sci. Phila. 1872, p. 154.
C. costatum Verrill, Am. Journ. Sci., 3d Ser., iii. p. 283, pl. 6, fig. 6, 1872.

Newer Miocene of the Cape Fear River, N. C., at Mrs. Guion's marl-pit, Johnson; Pliocene of Shell Creek, Florida, Willcox, and of the Caloosahatchie, Dall; living from Vineyard Sound, Mass., to Florida and the Antilles.

The Marquis de Folin observes that this differs from *C. imbricatum* Cpr. of the West Indies by being longer, more conical and having more strongly marked sculpture. The specimens of *C. imbricatum* given by Dr. Carpenter to the National collection are much more arched in their curve and relatively more slender.

The species named *C. Cooperi* by Dr. Carpenter from California is of later date, and the change of name must apply to it and not to the Eastern shell. It is observable on this species, and in nearly all the others which I have examined, that, judged by the longitudinal ribs, most of the specimens are slightly twisted, the amount of twist being variable, but giving evidence of an atavistic tendency which they have not yet been able wholly to overcome.

Cæcum californicum Dall.

C. Cooperi Cpr., Rep. Brit. Assoc. 1864, p. 655; not of Smith.
C. californicum Dall, Proc. U. S. Nat. Mus. 1885, p. 541; Tryon, Man. viii. p. 219, pl. 66, fig. 65, 1886.

Pliocene of Lower California at San Quentin Bay, C. R. Orcutt; Post-Pliocene of Coronado beach, San Diego, Cal., Stearns; living on the coast of California at San Diego, Cooper, Orcutt, etc.

This is a finely annulated, compact species, with a slightly contracted aperture.

Cæcum crebricinctum Carpenter.

C. crebricinctum Cpr., Proc. Cal. Acad. Sci. iii. p. 215, 1865; Tryon, Man. viii. p. 218, pl. 67, fig. 71, 1886.
C. magnum Stearns, Tryon, Man. viii. p. 219, pl. 67, fig. 83, 1886.

Fossil in the Pliocene of San Quentin Bay, Lower California, Orcutt; Post-Pliocene of San Diego, Cal., at Coronado beach, and living on the coast of California from San Pedro to San Diego in shallow water.

This is a very large brownish species, with strong extremely close-set annulations and a conical plug with the mucro slightly right-handed.

Cæcum glabrum Montagu.

Dentalium glabrum Mont., Test. Brit. ii. p. 497, 1803.
Cæcum glabrum Fleming, Edinb. Encyc., pl. 204, f. 7, 1817.
Odontidium levissimum Cantraine, Bull. Brux. ix. p. 2, 1842.
Brochus glabrus Brown, Ill. Conch. Grt. Brit., p. 125, pl. 56, f. 3.
Brochina glabra Cpr., Mon. Cæcidæ, P. Z. S. 1858, p. 23.

Chesapeake Miocene at Yorktown, Va., Meyer; Pliocene (Crag) of Britain and of the Caloosahatchie, Dall; Post-Pliocene of Norway, Sars; living on the coasts of Europe, both Atlantic and Mediterranean, and in the Canary Islands, on the east coast of America from North Carolina to Florida, U. S. Fish Commission, Jewett, etc.

The specimens of this widely distributed form were identified by the Marquis de Folin.

Cæcum carolinianum n. s.

Plate 22, figure 25.

Pliocene of the Caloosahatchie, Dall; living off the coast of North Carolina in fourteen to eighteen fathoms, U. S. Fish Commission, and at Egmont Key, Florida, Jewett.

Shell well covered, when living, by a thin yellow, caducous epidermis, underneath which it is white or translucent, maculated or streaked with opaque white; shell stout, rather thick, short, arched; sculpture of an obsolete shagreening seen with difficulty even with a lens, but which comprises faint longitudinal striæ, faint annulations and dichotomous impressed lines; the annulations are best visible near the aperture, the longitudinals on the back of the arch; aperture simple, the shell about it slightly enlarged, but not marginate; posterior end simple, plug conical, the mucro formed by the apex of the cone, which is slightly truncate and to the right hand of the median plane of the shell. Lon. 4.75; diam. of aperture 1.0; of posterior end $\frac{11}{16}$ mm.

The description has been drawn from the recent specimens, as the fossil ones were not adult. They have been examined by M. de Folin and were pronounced by him to be undescribed.

Cæcum tortile n. s.

Plate 13, figure 9 a.

Newer Miocene of the Cape Fear River, N. C., at Mrs. Guion's marl-bed, Johnson; Pliocene of the Waccamaw beds at Tilly's Lake, S. C., Johnson; living twenty-five miles off Cape Hatteras, N. C., in 63 fathoms, U. S. Fish Commission.

Shell rather large, solid, moderately tapered, slightly twisted, so that it is curved in two directions; aperture simple, nearly at right angles to the longitudinal axis; posterior margin simple, plug conical, slightly inclined to the right; longitudinal sculpture of numerous sharply incised lines, with wider interspaces, which in passing from the posterior to the anterior margin make as much as one-fourth of a revolution around the shell. Lon. of shell 6.12; diam. of anterior end 1.12; of posterior end 0.6 mm.

The amount of twist varies considerably in different specimens; some show very little, but in the best-preserved specimens it sometimes reaches one-quarter of a revolution. The following species is the only one which approaches *C. tortile*, apart from the torsion.

Cæcum (**tortile** var.?) **ibex** n. s.

Plate 20, figure 10 a.

Newer Miocene of the Cape Fear River, N. C., at Mrs. Guion's; Pliocene of the Waccamaw beds at Tilly's Lake, S. C., Johnson.

Shell resembling *C. tortile*, except in the following particulars: it is slightly more slender, with fewer and coarser ribs, which are separated by perceptible channels, across which the lines of growth are rather strong, giving the shell a faintly reticulated aspect; the anterior aperture is slightly contracted and the external edge bevelled; the form is slightly more conical. Max. lon. of shell 5.5; diam. of anterior end 0.8; of posterior end 0.4 mm.

The shells sometimes, like nearly all the elongated and longitudinally sculptured Cæcids, exhibit a moderate amount of torsion, but most of them are straight. *C. Stevensoni* Meyer is a similar species, but smaller, shorter, and with annulations often visible near the extremities.

Genus **MEIOCERAS** Carpenter.

Meioceras Cpr., P. Z. S. 1858, p. 26.
Inflatulum Cpr., Mazatlan Cat. B. M., p. 314, note; *ex parte*.
Bovicornu Meyer, Ala. Geol. Rep., p. 79 (under *Pteropoda*) 1886.

The species of this group cannot be determined from the shell in its younger stage, as individuals vary considerably.

Meioceras eocenense (Meyer).

Bovicornu eocenense Meyer, Ala. Geol. Rep., p. 79, pl. 3, fig. 12, 1886; Red Bluff, Miss.
Bovicornu gracile Meyer, Ber. Senck. Nat. Ges. 1887, p. 9, pl. ii. f. 17; Jackson, Miss.
? *Styliola corpulenta* Meyer, Ber. Senck. Nat. Ges. 1887, p. 9, pl. ii. f. 16; Jackson, Miss.

Upper Eocene of Mississippi, Meyer and Aldrich.

There may be three and probably are two species indicated here, but they cannot be defined until the adult forms are known. At present all that is indicated by Meyer's data is that the genus *Meioceras* exists in the Upper Eocene of Mississippi. I have not seen Meyer's type of *Styliola corpulenta*, but the form and size point toward *Meioceras*, and I have very little doubt that it should be referred there.

Meioceras nitidum Stimpson.

Cæcum nitidum Stm., Proc. Bost. Soc. Nat. Hist. iv. p. 112, 1851.
Meioceras nitidum Cpr., P. Z. S. 1858, p. 26.

Pliocene of the Caloosahatchie, Dall; Post-Pliocene of Barbados, Cpr.; living from Tampa Bay, West Florida, to Jamaica, West Indies.

This was obtained both adult and in the "*Bovicornu*" stage.

Meioceras cingulatum n. s.

Plate 16, figures 6, 7.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox.

Shell small, polished, sculptured only with incremental lines; back strongly arched; equator tumidly girdled, posterior extremity attenuated; anterior extreme larger, with the aperture much depressed; plug conical, mucro somewhat dorsally situated. Lon. of shell 2.25; diam. of anterior end 0.5; of posterior end 0.3 mm.

There is quite a range of variation in this species, in regard to the limits of the tumid zone. In many, as in the one which has been figured, it gradually merges in the rest of the surface. In other specimens it is sharply limited and has the appearance of a thick belt around the shell. In many specimens the mucro of the plug projects farther from the posterior aperture, and forms an obtusely rounded cone merging into the surface of the plug without specific limits.

FAMILY VERMETIDÆ.

This group is not very well represented in the American Tertiary. Since the character of the operculum, upon which the group is divided in the recent species, is not available in the case of the fossil forms, we can only approximate to the genus in many cases. For practical purposes our species may be divided into the following groups:

Shell large, contorted, with an irregular coil and no internal laminæ; *Serpulorbis.*
Shell large, with a turritelloid tip; *Vermicularia.*
Shell smaller, with internal laminæ near the tip of the spire; *Petaloconchus.*
Shell slit for access of water to the gills; *Siliquaria.*

Genus **SERPULORBIS** Sassi.

Serpulorbis herculea Dall.

Lesueur's Walnut Hills Fossil Shells, pl. 4, figure 20, 1829.

Later Eocene at Jarves' Spring, Hernando Co., Florida, Willcox.

Tube large, rather thin, irregularly coiled, without external sculpture except well-marked, more or less irregular incremental lines; section of the aperture circular. Length to diameter of aperture as about 1 to 15; maximum length of specimens about 300 mm.

This shell might be taken for a *Teredo* tube, it is so thin and plain, but the incremental striæ point toward the *Vermetidæ* rather than anything else. Mr. Willcox found this shell abundant at Jarves' Spring, many of the pieces reaching a foot in length. Owing to the flinty character of this rock and the tenuity of the shell, it is impossible to obtain complete examples.

Serpulorbis granifera Say.

Serpula granifera Say, Journ. Acad. Nat. Sciences, 1st Ser. iv. p. 154, pl. 8, fig. 4, 1824; Miocene, Maryland.

Latest Eocene at Martin's Station, Hernando County, Florida, Willcox; older Miocene of Ballast Point, Tampa Bay and White Beach, near Osprey, Florida, Dall; and at City Point, Va., Haldeman, and Maryland, Finch.

This species, when in good condition and with normal sculpture, is readily recognized. By some oversight it is omitted from both Conrad and Meek's lists of Miocene fossils of the United States.

Serpulorbis granifera var. **tenera** Dall.

Chesapeake Miocene, Duplin County, North Carolina, Willcox.

This differs from the creeping and decumbent form of the type in being aggregated in masses, with the tubes nearly vertical, in having the surface more distantly granular and the substance of the tubes much thinner, which, as they mutually support each other, is not detrimental to the individuals composing the mass. These tubes measure about 6.0 mm. in diameter at the aperture and reach a length of over 83 mm.

Vermetus papulosus Guppy, from the Miocene of Jamaica, bears some resemblance to a single tube of this variety, but is more slender and with larger granulations.

Serpulorbis (granifera var.?) ballistæ Dall.

Plate 22, figure 21.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Dall and Willcox.

Shell thin, rather rapidly enlarging, adherent, but with nearly circular section; sculpture of incremental lines and longitudinal riblets, of which the primaries are larger and granulated as in *granifera*, but instead of having the secondaries granulated and alternate, there are between each pair of primaries four or five simple secondary or smaller and subequal threads. A specimen about 60 mm. long has a diameter at the aperture of 8 mm.

Figure 13, plate 26, Tuomey and Holmes's Pleiocene Fos. S. Carolina, may represent this form; it is certainly not the *Petaloconchus*.

Serpulorbis decussata Gmelin.

Serpula decussata Gmelin, Syst. Nat. xiii. p. 3745, 1791.
Vermetus decussatus (Mörch) Tryon, Man. viii. p. 181, pl. 53, figs. 71, 72, 1886.

Older Miocene of Ballast Point, Tampa Bay, Florida, Dall, and of Santo Domingo, Gabb; Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox; Post-Pliocene, Simmons's Bluff, S. C., Burns; living on the shores of North Carolina, Florida and the Antilles, in twenty-two fathoms or less, U. S. Fish Commission, etc.

Subgenus **Vermicularia** Lamarck.

Serpulorbis (Vermicularia) spirata Philippi.

Vermiculus spiratus Phil., Arch. für Naturg., p. 244, 1836.
Vermetus lumbricalis Gould (*non* Lam.), Inv. Mass. i. p. 287, 1841; Conrad, Am. Jour. Sci. xxxviii. 109, 1835; name only.
Vermetus Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 288.
Vermetus carolinensis Conr., Proc. Acad. 1863, p. 568.
Vermicularia spirata Dall, Bull. U. S. Nat. Mus. 37, p. 144, 1889.
Vermetus radicula Stimpson, etc.

Pliocene of the Caloosahatchie, Shell Creek, Myakka River and Alligator Creek, Florida, Dall and Willcox; of the Croatan beds, Neuse River, N. C., Johnson; of Costa Rica, Gabb; living from Massachusetts Bay to the Southern Antilles in moderate depths of water.

This well-known recent form is widely distributed in the Pliocene, but I have seen nothing from the Miocene which could be referred to it except *Vermetus trilineatus* Guppy, which is based on the young spiral portion.

Genus **VERMETUS** (Adanson) Mörch.

Subgenus **Petaloconchus** Lea.

Vermetus (Petaloconchus) irregularis Orbigny.

Vermetus irregularis Orb., Moll. Cuba, i. p. 235, pl. xvii. f. 16, 18, 1842.
? *Serpula convoluta* H. C. Lea, Trans. Am. Phil. Soc. ix. p. 233, pl. 34, f. 1, 1845.

Pliocene of the Caloosahatchie beds, Dall; Post-Pliocene of the Floridian and Antillean coasts; and living in the same region from Cedar Keys, Florida, to the Southern Antilles, usually in shallow water.

Lea's species is certainly a *Vermetus*, and perhaps should be referred to this species.

Vermetus (Petaloconchus) varians Orbigny.

Vermetus varians Orb., Voy. Am. Mér., p. 456, pl. 54, figs. 7–10, 1843.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida; Pliocene of the Waccamaw beds and of the Caloosahatchie and Shell Creek, Willcox; Post-Pliocene of the Florida Keys; living from Southwest Florida south to Rio Janeiro, Orbigny.

The limits of species among the *Vermetidæ* are notoriously lax, and this species is but doubtfully distinct from the preceding. It is quite likely that its differences of form are due to station and food supply.

Vermetus (Petaloconchus) erectus Dall.

Vermetus (*Petaloconchus*) *erectus* Dall, Blake, Gastr., p. 262, pl. xxxviii. fig. 4; Three Cruises of the Blake, ii. p. 71, fig. 297, 1888.

Pliocene of the Caloosahatchie, Dall and Willcox; living in the Antilles in 37 to 805 fathoms, Blake Exp.

This species is easily discriminated from the others owing to its habit of building its early whorls together to form a rounded pedestal and then starting vertically upward with the remainder of the tube. It seems to be rare in the Pliocene marls.

Vermetus (Petaloconchus?) sp. indet.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida.

Two specimens of a *Vermetus* which do not seem to be referable to either of the preceding species were obtained from the silex-beds. They are not sufficiently complete to render it advisable to describe them under a new name in so difficult a genus as *Vermetus*. They comprise a tolerably regular spiral coil, gradually enlarging, smooth except for large, irregular swellings which have almost the effect of sculpture. The greatest diameter of the coil is 8.5 mm., and of the aperture about 3.0 mm. It is possible they may be tips of *V. squamulosa* Conrad, or *Serpula convoluta* H. C. Lea (1845, Miocene of Petersburg, Va.).

Vermetus (Petaloconchus) sculpturatus H. C. Lea.

Petaloconchus sculpturatus Lea, Trans. Am. Phil. Soc, 2d Ser. ix. p. 233, pl. 34, fig. 3, 1845; Emmons, Geol. Rep. N. Car., p. 271, fig. 169, 1858; not of Tuomey and Holmes, Pleioc. Fos. S. C., pl. 26, fig. 13, 1857.

Petaloconchus domingensis Sby., Quart. Journ. Geol. Soc. vi. p. 5, pl. x. fig. 9, 1849.

Chesapeake Miocene of Petersburg, Va., Lea; and of North Carolina, Emmons; and older Miocene of Haiti, Gabb.

This species is the type of the genus, and very well characterized by its peculiar turreted spiral growth and ornate sculpture. Gabb has fully identified the Santo Domingo fossil with Lea's species.

Among other fossils which have been referred to this general vicinity, *Serpula anguina* H. C. Lea is doubtless a *Vermetus*. *Serpula texana* Gabb, from the Eocene of Texas (Journ. Acad. Nat. Sci., 2d Ser. 4, p. 388, pl. 67, fig. 41, 1860), and *S. dianthus* Verrill, from the Post-Pliocene of Sankoty Head Mass. (Am. Journ. Sci., 3d Ser. x. p. 373, 1875), are genuine *Serpulæ*. *Serpula squamulosa* Conrad (Journ. Acad. Nat. Sci. vii. p. 149, 1834), from the Claibornian Eocene, is probably synonymous with *Serpula ornata* Lea (Contr. Geol., p. 37, pl. 1, fig. 5, 1833), and may be referable to *Serpulorbis*.

Vermetus ? (Anguinella) virginica Conrad.

Serpula virginica Conrad, Medial Tert., 3d page of cover to part of the editions of Nos. 1 and 2, Apr. 16, 1839.
Vermetus virginicus Orbigny, Prodr. Pal. iii. p. 48.
Anguinella virginiana Conr., Medial Tert., p. 77, pl. 44, f. 4, 1845; Proc. Acad. Nat. Sci. Phila. 1863, p. 568.
Vermetus anguina T. & H. (*non* Lea), Pleioc. Fos. S. C., p. 123, pl. 26, f. 12, 1857.

Older Miocene of Shiloh, N. J., and of White Beach, near Osprey, Florida, Dall; Chesapeake Miocene of Urbanna, Middlesex Co., Va., Conrad, and the Peedee River, S. C., Tuomey and Holmes.

This species I believe to be the test of a tubicolous annelid, but place it here, since the fact remains somewhat doubtful. It is concentrically ringed with a circular, somewhat campanulate aperture like the tubes of some species of *Serpula*.* Lea's *Serpula anguina* is a genuine *Vermetus* having a spiral larval shell. It may possibly be an irregular form of the same species which he named *S. convoluta*, but probably should not be referred, as has been done by Conrad, to the young of *P. sculpturatus*.

Genus **SILIQUARIA** Lamarck.

Of late it has been the fashion to use *Tenagodus*, *Tenagoda* or *Tenagodes* for this group and ascribe the name to Guettard (1774). I have not been able to consult Guettard's memoir, but, from the doubt exhibited as to the termination and the mode of certain citations, it seems unsettled that Guettard used any Latin name for the genus. Deshayes cites "Tenagode" simply, and such a trivial name in the vernacular has no just claim to recognition.

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* Another species which should probably be referred to *Serpula* has even, irregularly coiled tubes, smooth or slightly granular of surface and a little flattened on one side. They average about 2 mm. in diameter and 36 mm. long. They taper but slightly except in the earlier portion, which has occasionally some obsolete, little-elevated longitudinal lines. For purposes of reference it may take the name of *Serpula mendica*. It is found in the Pliocene of the Caloosahatchie and the Myakka River, Florida.

Siliquaria vitis Conrad.

Siliquaria vitis Conr., Fos. Tert. Form., part 3, 1st ed., p. 36; Aug., 1833, 2d ed., p. 47, pl. 17, f. ~~3~~2, 1835.
Siliquaria claibornensis Lea, Contr. Geology, p. 33, pl. 1, fig. 1, Dec., 1833; Gregorio, p. 121, pl. x. f. 42.
Tenagoda vitis Conr., Am. Journ. Conch. 1, p. 33, 1865.

Eocene of the Claiborne Sands, Conrad and Lea; older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, Dall.

I can see no distinguishing characters between the specimens from the Upper Eocene and those of the Lower Miocene.

De Gregorio has figured a number of varieties of this species (pl. x. figs. 41, 44, 45; xi. figs. 1, 2), and proposes for the smooth ones the varietal name of *plita*.

Other species of this group seem to be rare in the American Tertiary. The only one I have encountered is *Siliquaria sculpturata* Gabb (Journ. Acad. Nat. Sci. Phila., 2d Ser. viii. p. 364, pl. 46, fig. 59 a, 1874), which is synonymous with *S. squamata* Blainville, a recent species abundant in the Antilles at the present day. Gabb's fossil came from the Pliocene clays of Costa Rica.

It may be as well to note here that Gabb and others have frequently used the name *Siliquaria* in the sense in which it was used by Schumacher, to denominate a Pelecypod shell related to *Soletellina* or *Solen*.

Laxispira lumbricalis Gabb, from the New Jersey Cretaceous marl, from a careful examination of the type-specimens, appears to be simply an internal cast or mold of a species of *Siliquaria*. Such casts give no specific characters and simply indicate the presence of the genus. Having misinterpreted Gabb's very poor figure and applied the name *Laxispira* to a remarkable loosely coiled Trochid described by Prof. Verrill (U. S. Nat. Mus. Bull. 37, p. 166), it is necessary to replace Gabb's name, now obviously a complete synonym of *Siliquaria*, by another which shall be applicable to the Trochid, in question. I therefore propose for *Delphinula nitida* Ver. the name of *Eccliseogyra*, as a subgenus of *Liotia*.

FAMILY TURRITELLIDÆ.

Genus TURRITELLA Lamarck.

This genus is very abundantly represented in our Tertiaries, having made a good beginning in the Cretaceous. More than eighty species have been named and discriminated in the American Tertiaries. Of these, a certain proportion are synonyms, but a large number seem to be valid forms. I had intended to review the whole group in this place, but the difficulty of obtaining a sufficient number of specimens of this very variable genus to do the work properly, and the necessity of finishing this paper in a reasonable time, have obliged me to reconsider this determination. I shall, therefore, confine my attention to the Floridian species and their nearly allied congeners.

These alone are rather numerous, and in spite of my desire to restrict descriptions to well-characterized forms, I find that several require to be treated as new. Each horizon seems to have a set of forms which are analogous to those of preceding and subsequent horizons, and are, doubtless, genetically connected with them. A few species not belonging to the genus have been described by the older authors as Turritellas. Thus *T. æqualis* Say and *laqueata* and *perlaqueata* of Conrad belong to the genus *Turbonilla*. *T. vetusta* Conrad is probably a *Proto*. *T. monilifera* H. C. Lea, a doubtful species, *T. carinata* of the same author (not of I. Lea), *T. affinis* Gay, and *T. plana* Nelson bear specific names which are preoccupied in the genus. *T. alternata* Say is a *Bittium*; *T. costulata* Mighels and *T. erosa* Couthouy belong to Mörch's genus *Tachyrhynchus*. There are a number of species, such as *T. alticostata* Conrad, *constricta* Emmons, *eurynome* Whitfield, *fluxionalis* Rogers, *multilira* Whitfield (not *multilirata* Ad. and Rve.), *octonaria* Conrad, *præcincta* Conrad, *secta* Conrad, and *suturalis* Nelson (not of Sowerby), which have never been figured. *T. biseriata* Conrad and *T. terebriformis* Conrad are catalogue names of which no description or figure has been printed.

In our recent seas there is a singular dearth both of species and individuals. Very few are known even from tropical America, and only on the Pacific coast do one or two species offer any great abundance of individuals.

Turritella indenta Conrad.

T. indenta Conr., Journ. Acad. Nat. Sci. Phila. viii. p. 188, 1841; Proc. Acad. Nat. Sci. i. p. 32, 1843; Am. Journ. Conch. iii. p. 258, pl. 21, fig. 13, 1867.

Older Miocene of the Chipola River, Florida, one mile below Bailey's Ferry, Burns; Chesapeake Miocene of Calvert Cliffs and Plum Point, Md., Conrad and Harris.

The figure given by Conrad is too cylindrical, and the sides of the whorls insufficiently concave. The rib at the base of the whorls is often double, and the surface of the whole shell when perfect shows fine, faint spiral striæ.

Turritella indenta var. **bipertita** Conrad.

T. bipertita (*sic*) Conrad, Proc. Acad. Nat. Sci. Phila. i. p. 326, 1842; Am. Journ. Conch. iii. p. 258, pl. 21, fig. 1, 1867.

Chesapeake Miocene of Petersburg, Va., Conrad.

This differs from the type by the obsolescence of the two marginal carinæ of the whorls and the presence about the equator of several more or less pronounced striæ forming spiral threads by their interspaces.

Turritella indenta var. **martinensis** Dall.

Shell differing from the type by the development of the marginal riblets a little farther from the suture, and their frequent duplication by a fainter thread; on the upper whorls the posterior thread is generally undulate or beaded, and sometimes both are so. This form was obtained from the Vicksburg Eocene at Martin Station, Florida, by Mr. Joseph Willcox, and a cast which may be the same from the nummulitic limestone at Ocala.

Turritella indenta var. **mixta** Dall.

Chipola beds, near Bailey's Ferry, Chipola River, Northwest Florida, Burns.

This variety has the basal carina double as in well-developed specimens of the type, together with the equatorial spiral sculpture of *T. bipertita*. The lines of growth are periodically sharp and elevated, and the sides of the whorls are comparatively flat. The apical whorls are only faintly sculptured, and the nucleus is very minute. The best-preserved specimen measures 60 mm. long and has a maximum diameter of 21.5 mm. These specimens are somewhat more compact than the type, though it is quite variable in this respect.

Turritella tampæ Heilprin.

Plate 17, figure 8.

Turritella tampæ Heilprin, Trans. Wagn. Inst. i. p. 113, pl. 8, fig. 53, 1887.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, Willcox, Dall and Shepard.

This form is nearly related to *T. indenta*, especially the variety *martinensis*.

The original figure being very poor, the species has been refigured, but the new figure does not show one of the characteristic features of the species —namely, that the entire surface is covered with fine, sharp, but almost microscopic spiral threads. In good condition the species may be recognized by the separation at the suture of the later whorls and by the following sculpture : at the base of the whorl two little-elevated primary threads about a millimeter apart, the interspace sharply spirally striated ; behind the posterior primary the whorl is constricted, and covered thence to the suture by about six to eight spiral primaries with narrower, deep interspaces, the whole finely, evenly undulated by fine, regular, sometimes almost imbricated lines of growth. The posterior margin of the suture, when not discontinuous, is slightly more prominent. The base is flattish and spirally striate. The dimensions are 75 by 16 mm.

Turritella tampæ var. **tripartita** Dall.

Shell with the equatorial constriction marginate on both sides with a primary, and one marginating the suture behind ; the other primaries obsolete, the fine spiral striation remaining. The surface of the whorl is thus divided into three equal striated bands separated by two prominent threads. Two specimens of this variety were found among those collected at Ballast Point.

Turritella tampæ var. pagodæformis Heilprin.

Plate 17, figure 9.

T. pagodæformis Heilp., Trans. Wagn. Inst. i. p. 112, pl. 8, fig. 52, 1887.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, Willcox, Shepard and Burns.

This form appears, from more abundant and perfect material than that at Prof. Heilprin's disposal, to be essentially similar to the form which he described as *T. tampæ*, which is more abundant and seems to be the normal form of the species. In the present variety the whorls usually, but not always, overhang a little, they do not become discontinuous, while the primaries of the spiral sculpture are more pronounced than in the type.

There is still another form of the species which is more slender and has the constriction very pronounced, the carinæ much emphasized, especially the two near the base; and another in which the basal carina is prominent while the others are faint and the whorls nearly flat-sided; but it seems hardly worth while to apply names to such mutations at present. Each species of *Turritella* belonging to one general type runs through a very similar series of sculptural mutations; some types have many, others few, mutations; yet, in spite of all the variations, with a good series of perfect specimens the species can usually be recognized.

Turritella gatunensis Conrad.

Plate 17, figure 10.

Turritella gatunensis, Conr., Pacific R. R. Reports, vi. part 2, p. 72, pl. v. fig. 20, 1857; Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser. viii. p. 342, pl. 44, fig. 10, 1874.

Vicksburg Eocene at Martin Station, Florida, Dall and Willcox; Miocene of the Isthmus of Darien, on the Panama R. R. at Gatun, and Vamos-vamos, on the line of the canal, fourteen miles west of Colon, a few feet above the sea-level, Conrad and Agassiz; older Miocene of the Orthaulax bed at Ballast Point, Tampa, Florida, Dall and Willcox; Miocene of Costa Rica, near Pico Blanco, in Talamanca, Costa Rica, Gabb.

The identification of this species would hardly have been ventured upon if it had not been possible to compare with Panamic specimens. The *Turritella uvasana* of Conrad, from the figures extant, must be an extremely similar species, and perhaps identical with *T. gatunensis*. *T. arenicola* Conrad (Am. Journ. Conch. i. p. 141, pl. 10, fig. 11, 1865) seems also to be nearly related. It is from the Jackson Eocene.

Turritella megalobasis n. s.

Plate 17, figure 11.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Dall.

Shell large, broad at the base, conical, with rather faint sculpture and slightly overhanging, not discontinuous, whorls; whorls (decollate) nine or more, compact, covered with fine, dense, uniform, often wavy or vermiculate, nearly microscopic sculpture; whorl broadest at the base, where the margin overhangs the suture and presents a prominent rounded, rib-like edge; behind this, at not less than a third of the width of the whorl, are from three to eight little-elevated primary spirals irregularly spaced, and slightly undulated by the incremental lines; suture distinct, not channelled; sculpture fainter on the upper whorls; base flattish, slightly concave near the edge, spirally striate; aperture subquadrate with a moderate equatorial sinus. Lon. of specimen figured 64 mm.; max. diam. of base 28 mm.

The young have the base extremely concave and the pillar thin, arcuate, and so short that the aperture seems subtriangular. The full-grown shell is the widest species in proportion to its height that I know of, recent or fossil. It seems to be quite rare in the silex-beds.

Turritella terebriformis n. s.

Turritella terebriformis Conrad, Cat. Mio. Foss., Proc. Acad. Nat. Sci. Phila. 1863, p. 568; name only.

Older Miocene of the Chipola beds, Burns; Chesapeake Miocene of Yorktown, Va., Harris.

Shell acute-conic, with twenty-eight whorls and strong spiral sculpture; nucleus small, applied at an angle of 30°, followed by about six slender, smooth whorls, after which the spiral sculpture is gradually established; spiral sculpture on the adult whorls consisting of two basal ridges, rounded or square-topped, the anterior slightly smaller, with an equally wide channel between them; behind these the equator of the whorl is deeply, roundly excavated; behind this is another pair of ridges, the posterior the smaller, separated by a shallow sulcus, which as they ascend the spire gradually merge in the early whorls into a single ridge; behind these the whorl slopes evenly to the suture, which is applied below the anterior basal spiral; the surface also has many more or less evident spiral striæ; the transverse sculpture consists of faint undulations on the ridges due to accentuated lines of growth; the adult base is somewhat rounded, with three strong spirals, but which are hardly visible in the young; pillar short, arcuate, thin, so that the axis of the shell must have been more or less pervious. Lon. of shell 80 mm.; max. diam. of twenty-eighth whorl 16.5 mm.

Conrad's type-specimen, which he named but never described, and which Mr. Harris found in the collection of the Academy, enabled us to identify the Chipola fossil with his manuscript name. The specimens from Yorktown differ slightly from the Chipola fossil above described by being less emphatically sculptured, the posterior thread of the posterior pair being most generally wanting, but this is a difference such as is commonly found between Northern and Southern specimens of the same species.

The species is related to *perattenuata* Heilprin, *cumberlandia* Conr., *variabilis* and *exaltata* Conr., the two last of which are probably identical species.

T. altilira Conrad, from the Gatun Miocene, is so badly figured as to be a doubtful species; it is obviously closely allied to the present form. The form figured by Gabb from Sapote, Costa Rica, Miocene (Journ. Acad. Nat. Sci., 2d Ser. viii. p. 341, pl. 44, fig. 9, 1874) under the name of "*altilirata* Con.," whether identical with Conrad's *altilira* or not, is evidently allied to our species, but more drawn out and with stronger beading on the ridges. *T. terebriformis* is sometimes finely undulated on the ridges by the lines of growth, but this is less common in the Northern shells than in those from Chipola—a difference recognizable as due to latitude. *T. tornata* Guppy, from the old Miocene of Santo Domingo, is another form of the same group very similar to *T. altilira*.

Turritella chipolana n. s.

Plate 22, figure 24.

Older Miocene of the Chipola beds, Florida, Burns.

Shell strong, acute-conic, of eighteen or more whorls; nucleus decollate; early whorls showing one undulated posterior and one plain anterior spiral rib, with a less prominent one behind the suture; a fourth appears between the first two, and on the later whorls nearly equals them in size; on the last whorl we find at the basal margin a squarish primary spiral under which the suture is closely and evenly appressed; behind this is the most prominent spiral, then two slightly smaller, between which is the equatorial sulcus, in the middle of which is a very fine, sharp undulated line; between the last-mentioned primary and the suture behind it are two somewhat obscure spirals successively smaller; the equatorial and two anterior interspaces are nearly equal in width and channelled rather than excavated; the whole surface of the shell is covered with obscure spiral striations; the transverse sculpture undulates all the spirals on the later whorls and is formed by the lines of growth, which in some specimens are elevated and imbricate at intervals; the whorls are strongly sculptured to the tip, and rather rounded, the suture distinct, but nowhere discontinuous; the base in the young is flattish, somewhat excavated inside the marginal rib, the inner edge of the excavation forming a sort of disk about the pillar; in the adult the base is more convex, but without distinct spiral ribbing; the pillar is thin, arched, and so twisted that the axis of the shell, vertically regarded, is somewhat pervious; the aperture is somewhat rounded. Lon. of shell 68; max. diam of base 18 mm.

This species, which appears to be rare, is one of the most elegantly sculptured of the group. It recalls *T. mississippiensis* Conrad, from the Vicksburg, which is flatter and less ornamented. *T. indenta* var. *mixta* has a similar succession of spirals on the whorl, but they are comparatively feeble and grow feebler up the spire, while in *T. chipolana* they are, if anything, stronger. The latter is more slender, with rounder whorls and no tendency to discontinuity at the suture.

Turritella etiwanensis Tuomey and Holmes.

Terebellum etiwanensis T. and H., Pleioc. Fos. S. Car., p. 122, pl. 26, figs. 9, 10, 1857; Emmons, Geol. Rep. N. Car., p. 270, 1858.

Newer Miocene of Goose Creek and Peedee River, S. C., Holmes; of Cape Fear River, Johnson; abundant in the marls of Edgecombe Co., N. C., Emmons.

This form exhibits so much affinity to *T. variabilis* that I feel confident they may eventually be united.

Turritella striata Holmesii Dall.

Terebellum striatum T. and H., Pleioc. Fos. S. Car., p. 120, pl. 26, fig. 7, 1857.
T. Burdeni Emmons, Geol. Rep. N. Car., p. 270, fig. 163, 1858; not of Tuomey and Holmes.

Newer Miocene of Darlington, S. C., Holmes; of Cape Fear River, N. C., at Mrs. Purdy's marl-bed, Johnson.

This appears to be a good species, but the name *striata* seems to have been used in the genus by Lea and others before 1857.

Turritella Burdeni Tuomey and Holmes.

Terebellum Burdeni T. and H., Pleioc. Fos. S. Car., p. 122, pl. 26, fig. 11, 1857; not of Emmons.

Newer Miocene of the Peedee River, S. C., Holmes; of Cape Fear River, N. C., at Robinson's, Johnson.

The sculpture of this species is absolutely identical with that of some forms of *T. apicalis* Heilprin, but the single specimen I have seen and the figure of Tuomey and Holmes are broader at the base than in the Florida species. Whether this is a constant character must be determined by more abundant material and careful comparisons.

Turritella subgrundifera n. s.

Plate 22, figure 23.

Rather abundant in the older Miocene of the Chipola beds, Calhoun County, Florida, and represented by molds in the Sopchoppy limestone of the same age, from Wakulla County, Florida, Dall and Burns.

Shell thin, acute, with twenty-four sharply carinated sculptured whorls and a nucleus of two smooth, swollen whorls, of which the first is set obliquely to the axis of the adult shell; transverse sculpture only of lines of growth, which are not prominent and rarely undulate even the finest of the spirals; the periphery of the whorl is near the suture in front, and is ornamented with an extremely sharp keel, which overhangs, like eaves, the succeeding whorl; above this are four narrow less prominent keels or elevated spirals, with much wider about equal interspaces, which on the later whorls carry a fine intercalary spiral line; the surface is polished, but shows traces under the lens of microscopic spiral striæ; in front of the main carina are one or two elevated spirals between it and the almost invisible suture; the base inside of the sutural line is distantly spirally sculptured and rather convex; the aperture is subquadrate, the pillar arched, thin, and twisted so as to offer a minutely pervious axis; the throat is provided with strong sharp liræ independent of the sculpture. Lon. of shell 77; max. diam. of base 17 mm.

This is a very elegant and distinct species which in some of its features faintly recalls *T. imbricataria* Lam. of the Parisian Eocene.

The American species which is nearest to it in form, though a much smaller shell, is the unfigured *T. alticostata* from the Miocene of Virginia and Maryland. This has been identified from Conrad's type by Mr. Harris, but it has rounded, close-set threads and is only about half the size of the Chipola species. *T. alticostata* will probably turn out to be a carinated variety of *T. variabilis.*

It occasionally happens that the main carina in *T. subgrundifera* is no larger than the others, in which case, of course, the whorls have a more rounded appearance. But these specimens are rare compared with the carinated, which seems to be the normal form. It is the only fossil species here referred to with sharp liræ in the throat; the others have the throat quite smooth except in cases where the sculpture is reflected by sulci in the interior of the aperture.

Turritella subannulata Heilprin.

Plate 16, figures 1, 2, 3, 4.

T. subannulata Hp., Trans. Wagn. Inst. i. p. 89, pl. 8, fig. 17, 1887.

Abundant in the Pliocene marl of the Caloosahatchie and also found in the older Miocene of the Chipola beds, Burns; the Pliocene of Shell Creek, Florida, and Tilly's Lake, Waccamaw beds, South Carolina, Willcox and Johnson; also living (var. *acropora*) from Cape Hatteras to the Antilles (Grenada) and Vera Cruz, Mexico, in 3 to 413 fathoms.

This is a very remarkable species, which has been collected in such abundance as to throw a flood of light on the variations which may occur in a single species under essentially similar conditions, while the same species exhibits such an inflexibility of constitution as to persist, practically unchanged, for such an immense period as is implied by the interval between the deposition of the old Miocene Chipola beds and the present epoch. The figures on Plate 16 represent extremes which no one who did not possess intermediate gradations would for a moment hesitate to regard as "good species," while no doubt the gentlemen who amuse themselves and impede study by such work as is characteristic of the so-called "nouvelle école," would find fifty or sixty other "species" among the material before me.

It is not improbable that a complete collection of Vicksburg Eocene fossils, which is still a desideratum, would contain a precursor of the old Miocene form of this species, but the oldest material available for my present study is that from the Chipola beds. Here we have a form which is not distinguishable by any marked characters from the recent one described by the writer in 1889 (Rep. Blake Gastr., p. 264) as *T.* (*Torcula*) *acropora*. It is a slender shell covered all over with fine spiral grooving, which is peculiarly narrow and sharp, so that the interspaces form even, narrow, regular, elevated, close-set threads. The nucleus is smooth, obliquely set, minute and loosely coiled. The variations are few. The normal form has an equatorial larger thread which slightly angulates the whorl, and the spiral threads have a tendency to alternate in size, though the difference in size is slight. Under the glass here and there wider threads are seen among the others, and in the living *acropora* these wide ones are articulated with brown markings. The variations are—(1) the shell differs somewhat in slenderness, some being a little stouter than others; (2) the width of the spiral grooving varies, some having the grooves wider than others; (3) the tendency to alternation in size of the spiral threads is more or less pronounced, the threads being perfectly even and similar in some and regularly alternate in others, with all intermediate gradations; (4) in addition to the equatorial carina another is developed just behind the suture, or the equatorial carina becomes so feeble as not to interrupt the rounded outline of the whorl.

These variations are characteristic of the Miocene and recent shells, and the same types are found in the Pliocene also, but with many others. The variety *acropora* is figured from a Pliocene specimen on plate 16, as figure 4.

In the Pliocene the conditions of existence for the Turritellas seem to have been particularly favorable. In this species one evidence of this is the large size to which many of the specimens attain, and the perfection of their ornamentation.

The variety *acropora* appears as before, and is not rare. It shows the mutations above described and others. The latter may be specified as follows: (1) The number of wide spirals in proportion to the fine ones increases especially between the suture and the equator of the whorl in front of it; (2) the spirals, while increasing but little in size, become more distant and the equatorial carina less pronounced; this variety, which may be called var. *Burnsii*, has a coarser look and more rounded whorls than the type; (3) slight transverse waves cross the whorls, becoming most evident at the periphery and undulating the equatorial carina; all gradations in this respect may be observed; the combination which formed Prof. Heilprin's type, and which may be called var. *subannulata*, has the sutural and equatorial carinæ strong, wide spirals numerous behind the equator, narrow spirals elsewhere rather feeble, the undulations of the equator well marked and extending backward nearly to the suture; the shell rather stout, measuring 27 by 7 mm. This form is figured plate 16, figure 2. The same form with a feeble sutural carin is more slender and the undulations of the equator are more marked; this, which may be called var. *intermedia*, is figured on plate 16 as figure 3.

Lastly we have a variety, *perincisa* (plate 16, figure 1), in which the equatorial and sutural carinæ are very strong, the wide spirals behind the equator number three or four unusually strong with deep grooves between them, the sutural carina is duplex, all the preceding sculpture is distinctly undulated, and the fine spirals have become weak.

Turritella perattenuata Heilprin.

Plate 16, figures 5, 9.

T. perattenuata Heilprin, Trans. Wagn. Inst. i. p. 88, pl. 8, fig. 13, 1887.
? *T. tornata* Guppy, Quart. Journ. Geol. Soc., vol. xxii. p. 580, pl. 26, figs. 12, 18; *cf.* Gabb, Geol. St. Domingo, p. 240, 1873.

Pliocene of the Caloosahatchie beds, Shell Creek and the Myakka River, Willcox and Dall.

This elegant species belongs to the group which includes, in the Miocene, *variabilis*, *exaltata*, *cumberlandia*, *altilira* and *terebriformis* Conrad, *tornata* Guppy and *terstriata* Rogers, as will be seen by the remarks under the head of *T. terebriformis.* The number of accepted names will probably be diminished when sufficient material has been brought together and carefully studied.

The variations notable in the material which I have brought together, including several hundred specimens of all ages, may be classified as follows

1. Variety *obsoleta;* surface destitute of spiral sculpture except the angular borders of the equatorial sulcus and a faint line behind the suture.

2. Variety *undula;* the angular borders of the sulcus elevated into obliquely beaded, rope-like carinæ, the hollow of the sulcus without spirals.

3. Variety *perattenuata* (typical); the hollow of the sulcus with two beaded spirals and one or more on the shoulder behind the posterior carina. Old specimens tend to discontinuity at the suture in the last few whorls.

This species attains a length of 135.0 mm., with a maximum diameter at base of 13.5 mm.; a shell of this size exhibits forty-four whorls. It is very abundant on the Caloosahatchie and Shell Creek in the marls. Its nearest living analogue would seem to be *T. exoleta* L. of the Gulf of Mexico. The original figure is now supplemented by a better drawing.

Turritella apicalis Heilprin.

Plate 16, figures 10, 11, 12, 13.

Turritella apicalis Heilp., Trans. Wagn. Inst. i. p. 88, pl. 8, figs. 14, 14 a, 1887.
Turritella cingulata Heilp., *op. cit.* p. 89, pl. 8, fig. 15; not of Hisinger, Sowerby or Hupé.
Turritella mediosulcata Heilp., *op. cit.* p. 89, pl. 8, fig. 16.

Pliocene of the Caloosahatchie beds, Shell Creek and Myakka River, Dall and Willcox.

The appearance of the figures given on plate 16 will doubtless arouse some skepticism in regard to including them in a single species. I should be skeptical myself if I had only the figures to judge by; but I must remind my readers that the figures represent only extremes; the gradations between which are extant and may be examined in the collection, but which I could hardly try to figure *in extenso*.

A fact which I have verified in my study of the genus *Turritella* is that in many forms the rotundity or flatness of the whorls is a feature which marches with elevated spiral sculpture even when the rotundity would remain if the spirals were ground off the whorl. And this is not merely true of different specimens, but may be verified by the student on one and the same specimen when, as sometimes happens, the early whorls are destitute of spirals. It will be seen that, in such a case, the whorls near the apex are much flatter than those later on where the elevated spiral sculpture is developed. Of course, there may be species without spiral sculpture which have round whorls, or species having spiral elevated lines on flat whorls, but that does not invalidate the observation as above limited.

It will be observed that the flat-sided specimens, figures 11 and 12, have little or no elevated spiral sculpture, whereas it is strong on figures 10 and 13, which have round whorls.

1. Variety *mediosulcata* Heilprin, pl. 16, fig. 12. Beginning with the most feebly sculptured form, we find that it has fine spiral striæ all over the surface, there is a feeble constriction of the equator of the whorl, in front of which are three faintly indicated raised spirals, and behind which are two still fainter ones, slightly rippled by the incremental lines.

This variety is very variable, no two specimens showing exactly the same sculpture; the specimen figured is Prof. Heilprin's type. Most of the specimens have slightly rounder whorls and stronger primary spirals than this one, but the variety is a rare one compared with the typical form.

2. Variety *cingulata* Heilprin, pl. 16, fig. 11. Here we have the equator with three narrow sulci instead of one broad one, and a faint spiral rib in front of these. The surface, where not worn, is covered with fine spiral striæ. The whorls are rather flat, and the variety is very rare. I have seen but two specimens. It leads directly to the next variety.

3. Variety *tensa* Dall, pl. 16, fig. 13. In this form we have first the faint anterior three and posterior two faint spirals of *mediosulcata* become strong, their interspaces narrow and deeper, and the equatorial sulcus also narrower. The spirals are rippled by the incremental lines and the whorl is slightly more rounded; the fine striæ persist over the surface. An absolutely unbroken transition can be traced between the specimens figured at numbers 11 and 13. The type measures 78 by 13 mm. and came from the Caloosahatchie, where this variety is rare, but it is very common on Shell Creek.

4. *T. apicalis*, typical form, pl. 16, fig. 10. In this we have a beaded

carina on each side of the equatorial sulcus which may be simply finely spirally striate or have one or two beaded spiral threads, like those of var. *cingulata*, in it. The basal margin is formed by a spiral rib, and there are often two faint ribs between the shoulder of the whorl and the suture. This form reaches a length of 72 mm., and a basal diameter of 12 mm.

For those who insist on dividing specifically specimens which may be the progeny of a single pair, the above varietal names may take specific rank. For myself, I believe, in the present state of science, that most stress should be laid upon the relationship, rather than trifling points of difference, since, in the dust-cloud of names applied to every individual mutation, all general principles become obscured.

I may add that the Pliocene *Turritella Cooperi* Carpenter, which has persisted until recent times on the Pacific Coast, and was collected by Orcutt at San Quentin Bay, Lower California, with other Pliocene fossils, has a quite marked general resemblance to *T. apicalis*, though a ruder and less elegantly sculptured shell.

FAMILY MATHILDIIDÆ.

Genus Tuba Lea.

Tuba Lea, Contr. Geol., p. 127, 1833. Type *T. striata* Lea ; Conrad, Am. J. Conch. i. p. 34, 1865.

Mathilda Semper, Journ. de Conchyl. xiii. p. 328, 1865 ; Dall, Rep. Blake Gastr., p. 266, 1889.

Cingulina A. Adams, Ann. Mag. N. H. 1860, vol. vi. p. 414 ; *fide* Newton.

Gegania Jeffreys, P. Z. S. 1884, p. 365, pl. xxvii. fig. 10, 1884 ; R. B. Newton, Brit. Olig. Eoc. Moll., p. 209, 1891 ; Dall, Rep. Blake Gastr., p. 268, 1889.

Acrocœlum Cossmann, Cat. Eoc. Paris, iii. p. 315, 1888.

The forms grouped under this genus have met with various fortune in nomenclature. The type of the genus is a large species (when adult) of the same character as that subsequently described by Jeffreys as *Gegania*. *Cingulina* A. Adams (not of Monterosato, 1880) is treated by Newton as equivalent to the later *Mathilda* of Semper. There is nothing in Adams's diagnosis and description of his single type-species (*C. circinata*) to oppose or confirm this statement; in fact, it would be impossible for any one to refer *Cingulina* to its family from any information furnished by Adams. It is to be supposed that Mr. Newton's information was derived from an examination of Adams's type-specimen in the British Museum collection. It is to be regretted that he has not informed his readers of his reasons for the identification, especially as his course in matters of nomenclature in several cases has been such as to render necessary a thorough investigation of each case before his proposed changes or statements, as of fact, can be safely accepted. The type of *Cingulina* has not, I believe, been figured.

Semper, on the other hand, has fully and sufficiently described his genus, of which the type is *M. quadricarinata* Brocchi. It differs from *Tuba* s. s. in being more slender, and in having the sinistral nucleus not immersed, or only partially so, and in having more whorls in the nuclear portion, and, so far as I have been able to discover, in these particulars only.

Gegania is an absolute synonym of *Tuba;* both have a sinistral nucleus, which is, however, so far immersed, or of such small coil, as to appear to a casual examination merely gibbous and dextral. I have verified this fact by most careful study of the typical specimens of Lea and Jeffreys.

The section *Acrocœlum* Cossmann is based on a species which has the nuclear whorls, as shown by his figure, horizontal, capping the spire with the actual apex immersed, instead of projecting as in *Mathilda*, or immersed at top of a conical coil as in *Tuba*.

The sinistrorsity of the nucleus in Gastropods is of less systematic value than formerly supposed. Many species of *Calliostoma* have a reversed nucleus without differing in other respects from their congeners. If the true nucleus is so short as not to form a coil, it is obvious that the tendency which would have made a coil sinistral if it exists will be so masked as to be barely recognizable, or not at all. That this is often the case, I have fully satisfied myself. For this reason I am unable to accept the valuation placed by some excellent authorities on this feature. In the present case it may be said that the genus *Tuba* and its sections *Mathilda* and *Acrocœlum* have a nucleus of which the initial tendency is sinistral, but in which this tendency is realized in a sinistral coil exposed to view and vertically tipped aside only in *Mathilda*, while in *Tuba* s. s. the coil is very short and mostly immersed in the subsequent apical whorls, and in *Acrocœlum* a coil is probably not formed, the apical point of the nucleus being simply immersed.

In all the species there is an effuse tendency at the base of the pillar recalling *Trichotropis*, but which is emphasized by a slight thickening on the pillar only in rare cases. Still, some of the species, or some specimens in some of the species, do show such a slight callosity, like the one about to be described. This feature is more likely to be found in those species with a strong, straight pillar and strong basal spiral sculpture than in those like *Tuba antiquata*, in which the basal sculpture is faint and the aperture more orbicular. In short, this character is dynamic and analogous to that exhibited by *Pyrgula annulata*, which for the same reasons exhibits an effuse aperture, though belonging to a group in which the aperture is normally entire in front.

Tuba acutissima n. s.

Plate 18, figure 4 a.

Miocene of the Chipola epoch, in the lower bed at Alum Bluff, Chattahoochee River, Northwest Florida; Burns.

Shell with eight or nine rapidly enlarging whorls; nucleus minute, decollate in all the specimens, but from the slenderness of the subsequent whorls evidently not immersed; the three whorls succeeding the decollation nearly smooth, gradually taking on faint spiral striation which in the later whorls becomes a rather uniform series of sharp threads to the number of five or six above the periphery, separated by wider interspaces; on the base the spirals are still more sparse, except around the umbilicus; transverse sculpture of closer, fine, elevated lines most prominent in the interspaces and covering the whole surface in harmony with the lines of growth; whorls rounded and full, except at the periphery, which is more or less distinctly angulated; base convex, with an obscure angle about its middle; umbilicus distinct, variable in size, funicular, shadowed in front by the inner lip; pillar arched, thin, sometimes with a slight callus near the anterior end; aperture gibbously lunate, effuse near the pillar, slightly angulated by the basal and peripheral angles; a thin wash of callus covers the body, the throat is smooth; the suture is very distinct and runs a little below the peripheral angle. Alt. of shell 7.5; max. diam. 5 mm.

This species has somewhat the aspect of a *Trichotropis* on account of the effuse aperture and angulated periphery. As the nucleus is not immersed, it is interesting as combining the broad form of *Tuba* proper with the naked nuclear coil of the section *Mathilda*, thus illustrating the slight systematic value which the characters relied on to separate the groups really possess.

The genus *Tuba* in America is first known in the Eocene. *Tuba bella* Conrad, from the Upper Cretaceous of Alabama, has been referred to *Spironema* Meek, a genus of *Litorinidæ*. Lea's type, *T. striata*, is now known to include both his other species, *T. alternata* and *sulcata*, and, according to Conrad, is a synonym of the unfigured *Littorina antiquata* Conrad (Fos. Tert. Form. U. S., No. 3, p. 35). *Pasithea cancellata* H. C. Lea (Am. Journ. Sci. xl. p. 93, pl. 1, fig. 2, 1841) should also be referred to this genus. All the preceding are from the Claibornian. From Jackson, Miss., Meyer has described (Bull. Ala. Geol. Surv. i., 1886, p. 68, pl. 2, fig. 1) an *Eglisia regularis* which he has since referred to the genus *Mathilda*.

FAMILY LITORINIDÆ.

Genus **LITORINA** Férussac.

Litorina irrorata Say.

Turbo irroratus Say, Journ. Acad. Nat. Sci. ii. p. 239, 1822.

Litorina lineata Emmons, Geol. Rep. N. Car., pp. 256, 271, fig. 170, 1858; not of Gmelin (young shell).

Litorina irrorata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 119, pl. 26, fig. 5, 1857; *ibid.*, Post-Pl. Fos., p. 91, pl. 14, fig. 5, 1860.

Litorina carolinensis Conr., Proc. Acad. Nat. Sci. Phila. 1863, p. 567.

Rare in the newer Miocene of South Carolina, Holmes; in the upper Miocene of Wilmington, N. C., near the Carolina Central R. R. station, Clark; Pliocene of De Leon Springs, Florida, B. H. Wright; Post-Pliocene of both the Carolinas, Holmes and Burns; living on the coast of the United States from Rhode Island to Florida and Texas, and in the Antilles to Jamaica.

I have carefully compared the specimens of the recent and fossil forms, and find them quite identical, unless it is that the fossil is slightly more slender and not quite so large as the majority of the recent specimens. The difference is not greater than many of the recent specimens show among themselves. If, however, it be felt necessary to discriminate them by name, that of Conrad may be used in a varietal sense. He has figured (Geol. Rep. N. Car. App., p. 23, pl. 4, figs. 10, 11, 1875) an adult and a partly-grown shell of the fossil as *S. carolinensis* and variety. The alternation in size of the spiral lines, which is the character he seems to rely on to separate the recent from the fossil shell, is not a constant character, individuals with either kind of striation being found among the recent specimens.

Of other Tertiary American species it may be noted that *L. antiquata* Conrad is a *Tuba; L. Pedroana* Conrad, from the Pacific Coast Pliocene, is *Lacuna solidula* Lovén; *Litorina patula* Gould, from the California Pliocene, is *L. planaxis* Philippi, also found living; *L. Rèmondi* Gabb, from the Pliocene of Kirker's Pass, California, seems to belong to the same group as *L. irrorata; L. palliata* Say is reported from the Post-Pliocene of Labrador, and *L. rudis* Donovan also occurs in similar beds southward.

FAMILY FOSSARIDÆ.

Genus **FOSSARUS** (Adanson) Philippi.

Fossar Adanson, Hist. Coq. Sen., pl. 13, 1757; Philippi. Moll. Sicil. i. p. 167, 1836.
Fossarus Philippi, Archiv für Naturg. 1841, i. p. 42.
Maravignia, Aradas and Maggiore, Atti del Acad. Gioenia de Catania, Ser. i., vol. xvii., for 1840 (extras p. 42), 1841.
Carinorbis Conrad, Proc. Acad. Nat. Sci. Phila. for 1862, p. 288, 1863.
Delphinula sp. Lea, Conrad, Emmons, etc.

The genus *Fossarus* was indicated by Philippi with a reference to Adanson's name in 1836, but the name was not regularly proposed in Latin form until March, 1841. The genus *Maravignia*, according to Aradas,* was founded on a monstrous or deformed specimen of *Fossarus Adansonii* of which the anomalous character was not recognized, but which gave to the shell characters which made it impossible to refer it to any known genus. Its real relations remained unknown for forty years, and when recognized, Aradas with great propriety declined to claim for it any rights as opposed to the universally accepted name of Philippi. Some authors who seem to enjoy disturbing any well-settled name have lately endeavored to make the substitution, though the question of priority is by no means established in favor of *Maravignia;* the notorious antedating of the title-pages of these publications lending little probability to the claim that the volume for 1840, published in

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* Atti Acad. Gioenia, 3d Ser. vi. p. 181, 1871.

1841, really appeared before the first number of Wiegman's Archives for that year. Until the claim is perfectly established, and the right of way for names based on monstrosities is generally admitted, we shall heartily join with the judicious author of *Maravignia* in regarding it as inadmissible.

Fossarus lyra Conrad.

Plate 18, figure 3 a.

Delphinula lyra Conrad, Journ. Acad. Nat. Sci. vii. p. 141, 1835.
Delphinula globulus H. C. Lea, Trans. Am. Phila. Soc., 2d Ser. ix. p. 36 (extra copies), pl. 36, fig. 74, 1845.
Delphinula lyra Conrad, Proc. Acad. Nat. Sci. iii. p. 20, pl. 1, fig. 27.
Delphinula quadricostata Emmons, Rep. Geol. Sur. N. Car., p. 272, fig. 180, 1858.
Adeorbis (*sp.*) Emmons, *op. cit.* p. 272, fig. 181, p. 258, 1858.
Carinorbis lyra Conrad, Proc. Acad. Nat. Sci. for 1862, pp. 288, 570, 1863; Meek, Miocene Checklist, p. 14, 1864.
Carinorbis quadricostata Conrad, *op. cit.* p. 570, 1863; Meek, Miocene Checklist, p. 14, 1864; (in *Rotellidæ!*).

Chesapeake Miocene of Suffolk, Virginia, Conrad, and Petersburg, H. C. Lea; also at Mrs. Guion's marl-bed on the Cape Fear River, C. W. Johnson; and near the Natural Well, Duplin Co., North Carolina, Burns.

This very elegant shell does not appear in the Pliocene or recent faunas, as far as known. It is represented in the present fauna of the coast by *F. elegans* Verrill, which is well distinguished from *F. lyra* by its specific characters.

Subgenus **Isapis** H. and A. Adams.

Fossarus (Isapis) anomala C. B. Adams.

Plate 9, figure 10.

Narica? anomala C. B. Adams, Contr. to Conch., p. 109, April, 1850.
Isapis anomala H. and A. Adams, Gen. Rec. Moll. i. p. 320, pl. 33, fig. 8, 1853; Chenu, Man., p. 302, fig. 2135, 1861; Mörch, Mal. Blätt. xxiv. p. 96, 1877.
Fossarus anomalus Fischer, Journ. de Conchyl. xii. p. 256, 1864.
Dolium octocostatum Emmons, Rep. Geol. Surv. N. Car., p. 258, fig. 129 a, 1858; Conrad, Proc. Acad. Nat. Sci. for 1862, p. 564, 1863.
Isapis caloosaensis Dall, Trans. Wagn. Inst. iii. p. 187 (name only), pl. 9, fig. 10, 1890.

Miocene (or Pliocene?) of North Carolina, Emmons; of the Cape Fear River, at Mrs. Purdy's marl-bed, Johnson; Pliocene of the Caloosahatchie beds, Dall and Willcox; recent in the Antilles (Jamaica), Adams.

This species was among those which were figured before being thoroughly studied, and in this way a new name was inadvertently attached to it in Part I. of this paper. A careful examination and comparison with an authentic specimen of Adams's species demonstrated their identity. I have no doubt that Emmons's wretched figure is intended to represent this species, but he did not state in his text from what locality it came.

A remarkably large and fine species of this subgenus occurs in the older Miocene of Shiloh and Jericho, New Jersey, and has been described in his manuscript report on the Gastropods of the New Jersey marls, under the specific name of *Dallii* by Prof. R. P. Whitfield.

FAMILY SOLARIIDÆ.

Genus **SOLARIUM** Lamarck.

This group occurs in remarkable abundance in our Eocene, but has been generally misunderstood, the small Trochoid pearly shells properly called *Solariella* having here, as in Europe, been frequently described under the name of *Solarium*, which latter is never pearly, and belongs to a wholly diverse line of development.

The examination of our fossil species has led me to believe that a subdivision of them into sections would aid students in identifying the species, and it has therefore been attempted. It should be premised that the form of the shell in most of the groups may vary by having : (1) the whorls rounded at the periphery; or (2) the periphery keeled; or (3) with a shallow, wide sulcus on the top or base of the whorl near the periphery; or (4) by having the spiral sculpture simple or granular along the threads. These variations may occur within what we have been accustomed to regard as specific limits among the Eocene species, though perhaps in the existing fauna the limits of variation in these particulars are less inclusive.

Eliminating all the *Trochacea* and *Adeorbidæ* from among the species to be considered, we find the remainder fall naturally into four sections, which represent the groups respectively typified by *S. elaboratum* Conrad, *S. scrobiculatum* Conrad, *S. alveatum* Conrad, and *S. granulatum* Lamarck, and characterized as follows :

1. Section *Solariaxis;* shell with the umbilicus scalar, the umbilical wall with a rib between the umbilical carina (or basal margin of the umbilicus) and the suture above; the umbilical carina annulate; sculpture, except lines of growth, exclusively spiral, the spirals linear or granular; periphery rounded or sharp, with a feeble margination or none. Type *S. elaboratum* Conrad.

2. Section *Patulaxis;* shell with the umbilicus funicular; umbilical rib absent; umbilical carina tubercular; sculpture radial and spiral, usually feeble or obsolete; periphery sharp, thin, usually decumbent, not marginate. Type *S. scrobiculatum* Conrad.

3. Section *Stellaxis;* shell with the umbilicus scalar; umbilical rib threadlike; umbilical carina coarsely toothed; sculpture strong, not granular, sparse especially above; periphery carinate and strongly marginate. Type *S. alveatum* Conrad.

4. Section *Solarium* s. s. Umbilicus scalar, with no umbilical rib; umbilical carina annulate or tuberculate, set off from the base by a deep, narrow sulcus; surface sculptured in both senses, the radial sculpture well marked; periphery usually keeled, marginate or with prominent peripheral spiral ribs. Type *S. perspectivum* Lam., *S. granulatum* Lam., etc.

The species I have been able to examine comprise nearly all that have been known from our Tertiary and several new ones. They may be allotted places as follows :

Solariaxis. *S. elaboratum* Conr., with elevated, flattened, rounded and keeled varieties, which include *ornatum* Lea (more granular and rounded than the type), of which *canaliculatum* Conr. *non* Lam. is a synonym. The most elevated form of *S. elaboratum* I have seen is from Jackson, Miss., a specimen measuring 9 mm. high by 14 mm. in greatest diameter. This form was also remarkable for the intense development of annulation on all the spiral sculpture, including the peripheral keel, with elegant uniformity, giving a beaded rather than the usual subgranulate aspect. At nearly the opposite extreme of sculpture in the species are some specimens in Mr. Aldrich's collection from Gregg's Landing, Ala., which show the spirals nearly simple below, except the umbilical carina, and above only faintly articulated. These shells have a tendency to margination in front of the suture, and especially at the periphery, thus indicating the passage toward *S. acutum*. They also are exceptional in having two or three slender umbilical ribs instead of a single rather larger one, as is more usual.

The flatter forms of this have a very thin, wide margin, and tend toward the type *S. acutum* Conr., which includes *S. vespertinum* and *Meekianum* Gabb, both as mere sculpture-variations without any indication of constancy. In the typical *elaboratum* the umbilical walls are nearly vertical, and the umbilical rib (not the carina) is not specially prominent; in *ornatum* the umbilicus flares a little more and the rib is more projecting. *S. delphinuloides* Heilprin (not Meyer) belongs hereabouts. In *acutum* the umbilical carina has receded still more and the rib is very prominent; *S. Meekianum* only differs by having a small thread between the umbilical rib and the carina. The species in its different varieties is widespread in the Eocene.

S. Cossmanni n. s. (pl. 22, figs. 14, 14 a) has the umbilical carina prominent and coarsely annular, with half a dozen granular riblets forming a continuous series up to the umbilical rib proper; the latter is not very prominent. The whole sculpture is sparsely granular, the whorls obtusely carinate, depressed, with two strong granular ribs behind and a row of granules before the suture. This form has seven whorls, with an elevation of 6.0 and a max. diameter of 12.5 mm. The young have fewer spirals on the umbilical wall, and the adult shows a curious wrinkling of the incremental lines in the interspaces.

We have it from the Claiborne Sands, Gregg's Landing, Alabama, and the Eocene of Newton and the Wahtubbee Hills, Mississippi.

Near *S. Cossmanni* I place temporarily a young shell collected from Matthews' Landing, Alabama River, by L. C. Johnson, U. S. Geol. Survey, which may be called

S. alabamense n. s. (pl. 22, fig. 17). Shell with two and a half whorls beside the nucleus; umbilicus shaped like that of *Patulaxis* with no rib but, as well as the rest of the surface, finely regularly spirally threaded, the threads delicately reticulated by arcuate lines of growth; form depressed, the umbilical carina simple, the upper surface of the whorls somewhat rounded, but bordered by a double, elevated thread, while the periphery (including the lateral aspect of this thread) has a vertical surface, like the tire of a wheel, which offers three strong, elevated, rounded threads with two fine intercalary elevated lines. Alt. of shell 2.0; max. diam. 5.3 mm.

This interesting form is of course young, and may develop an umbilical rib, or may, when adult, have a decumbent keel, in which case it would be referable to *Patulaxis*. In its present state it differs from all the species of that section in its sculpture and its ribbed periphery, and from the young of all the species of *Solariaxis* by the absence of any well-defined umbilical rib. It may turn out to represent a distinct section.

S. periscelidum n. s. (pl. 22, fig. 11). Shell depressed, rather small, with four or more post-nuclear whorls; periphery with a rather strong annulate rib with a fainter one on each side, the one behind separated by a well-marked, sometimes excavated, interspace; suture appressed, with a granular line in front of it and often several feebler rows in front of that, the surface of this part of the whorl somewhat concave or flattish; base rounded from the keel to the umbilical carina, which is nodular, with or without a few broken fine spirals outside of it, crossed by weakening radial wrinkles; umbilicus rather wide, with a small, well-marked, annulate umbilical rib, and the walls transversely wrinkled and somewhat concave. Alt. 4.2; max. diam. 9.0 mm.

This interesting species is from Mr. Aldrich's collection, where I find three specimens from Matthews' Landing, on the Alabama River. Its nearest relative is *S. Aldrichi*, which has much coarser and somewhat different sculpture and a narrower umbilicus. The present species is destitute of the flat basal spirals of *S. Aldrichi*.

S. Aldrichi n. s. (pl. 22, figs. 13, 13 a) is another species of the same group, with beautifully compact and clear-cut sculpture. The umbilical rib and carina are equal and similar, the wall between them excavated; the carina has twenty-four strong annular tubercles, outside of which are three broad flat and three or four thread-like spirals, all, as well as the interspaces and umbilical wall, regularly wrinkled; outside of these is a more prominent thread, then a small one, then the broad, blunt peripheral carina; above there are two strong beaded threads, separated by a fine one behind, and in front of the suture a more or less conspicuous spiral, with three smaller ones in front of the latter. The shell is moderately depressed, and all the sculpture is regular and not sharply elevated. Alt. 5.5; diam. 10.5 mm. From Lisbon, Ala., and the Wahtubbee Hills.

S. Leanum n. s. (pl. 22, fig. 12) is from the Wahtubbee Eocene, and one of the most attractive forms of the group. The umbilical carina is annulate with nineteen strong, transversely-keeled tubercles, separated from the strong similar umbilical rib by an excavated sulcus; the rib is prominent, and looks, to a casual inspection, as if it were the top of the umbilical wall of the whorl, which is not the case; the shell is depressed, with a wide, thin carina, blunt and slightly undulate on the edge; both the under and upper surfaces of the whorls are concave; the keel overhangs the suture in front; the base outside of the umbilical carina is smooth, with a single fine thread in the bottom of the excavation; on the summit, above the keel, are four fine beaded or undulated spirals, separated by much wider interspaces, those next the suture stronger than the other two. Alt. 5.5; diam. 11.0 mm.; the apical whorls are estimated for, being defective in the type.

Patulaxis. *S. scrobiculatum* Conr. has the shell depressed, feebly striated, with a decumbent peripheral keel; umbilical carina strongly dentate, with about twenty-five triangular tubercles; there is a faint, fine transverse fluting or wrinkling on each side of the suture, strongest behind; the spiral striæ are fainter below and not stronger above than the incremental lines; we have it from the Claibornian, Wood's Bluff and Gregg's Landing, Ala.; Newton, Miss.; from Mt. Lebanon, La., and Wheelock, Tex. *S. texanum* Gabb has the upper surface without spiral striation, the middle of the whorl impressed, the suture simple-edged except in the very young, the periphery wider and less decumbent; the umbilicus smaller, with the carina very finely transversely wrinkled, the base smooth or with a few obsolete spiral lines. It comes from Wahtubbee Hills, Wood's Bluff, La., and Texas. In both the preceding the umbilical wall is marked only by lines of growth, and is flat or slightly concave.

S. cupola Heilprin (Proc. Acad. Nat. Sci. Phila. 1880, p. 375, pl. 20, fig. 14). Shell dome-shaped, variable in height, whorls excavated above, especially toward the apex, the peripheral keel strongly decumbent; whole surface, including the umbilical wall, sharply spirally threaded with fine alternate, elevated lines, those between the suture and the sulcus in front on the spire stronger; suture simple or microscopically wrinkled; umbilical keel with extremely fine wrinkles at the edge; umbilical wall slightly convex, umbilicus large; whorls seven. Alt. 4.75; max. diam. 18.0 mm. It is from Bashia Creek and Wood's Bluff, Ala. "*Discohelix*" *Dixoni* Vasseur (Cossm., Par. iii., pl. xi. figs. 1, 2), probably the young of *S. patulum* Lam., illustrates the form of the young shells of this group before the periphery becomes decumbent. *S. patulum* of course belongs to this section and is nearly related to, though distinct from, Conrad's *S. scrobiculatum*.

Stellaxis. The representative of this group is *Solarium alveatum* Conr. (+ *bilineatum* Lea). Its simple and sturdy sculpture, stellate umbilicus with spirally striate walls, carrying a single more elevated, fine, undulate thread, nearly smooth surface and sharply marginate base cannot be mistaken. The chief variations are due to the presence or absence of the two faintly impressed lines behind the suture on the spire. It is from the Eocene of Claiborne and Clark Co., Ala.; Jackson, Miss.; Creole Bluff, La.; Gonzales, Tex., and Orangeburg, S. C. *S. cognata* Gabb, from the Téjon Eocene of California, belongs near this group, if the figures are to be trusted.

Solarium s. s. Beginning with the less typical forms, *S. funginum* Conr. (+ *S. henrici* Lea) is well discriminated by its flattened dome with impressed suture, from which, on the spire as well as from the umbilical sulcus, sharply impressed lines radiate; the periphery is keeled and marginate and there are no other spiral lines. It is known from Claiborne, Clark Co. Ala., and Wahtubbee. *S. trilineatum* Conr. (Miocene of Plum Pt., Md.) is higher, with articulated bands on both sides the suture and more numerous incised spiral lines.

S. bellastriatum Conr. is a well-marked form of the same type, but larger, without beading or articulation in front of its deep-cut suture, with strong radial grooves above and below, and a single spiral groove on the middle of the base between the umbilical sulcus and the peripheral keels. We have it from Jackson and Garland's Creek, Miss.

A variety, *S. triliratum* Conr., has several basal grooves crossed by the radii and tessellating the interspaces; the upper surface of the whorls has a medial spiral groove cutting that part so as to form three flat bands between the sutures, including the broad upper peripheral keel; it comes from the Claiborne Sands, the Claiborne white limestone, Wahtubbee, Newton, Jackson, and Carson's Creek, Miss. It is smaller than the typical *bellastriatum.*

Another variety, *vicksburgensis* Dall (pl. 22, figs. 4, 4 a), has between the peripheral keel and the suture above four nearly equidistant incised lines, obliquely tessellating the surface when they cut the regularly spaced radial grooves. The base has four tessellated bands between the lower peripheral keel and the sutural sulcus; they decrease in width outward and the three outer ones are taken into the aperture by the proceeding whorl, together with the peripheral keel. Alt. 6.5; max. diam. 12.0 mm. in a specimen having six whorls. It is found in the Eocene of Vicksburg, Miss. If the figure given by Gabb of his *S. Hornii* of the Téjon beds of California be reliable, that species should be ranged in this vicinity.

Another variety of the *bellastriatum* type may be called *S.* var. *newtonense* Dall. It differs from the type by having the umbilical carina divided into two by a second narrow sulcus, and in having two adjacent narrow, incised spiral lines on the middle of the base, instead of a single one. The shell is small, about 5 by 10 mm. Several specimens are in the Aldrich collection from Newton, Miss. It recalls *S. cœlatura* Conr., but has a different upper surface.

S. amphitermum Dall is described later on. It is marked by its stout peripheral keel and marginating rib, both elegantly articulated by radiating grooves, and by the rest of the whorl being nearly smooth. It is a Miocene species from Greensboro', Md.

S. amœnum Conr. closely resembles *S. trilineatum*, but has two deep sulci around the umbilicus instead of one, and has three very clear-cut, strong peripheral keels, those of *trilineatum* being weaker. It is very close to the Miocene shell. *S. amœnum* has been received from Wahtubbee, Claiborne, and Orangeburg, S. C.

S. Johnsoni n. s. (pl. 22, figs. 15, 15 a) is about the size of *S. amœnum* and somewhat more elevated; the sculpture of the spire is very similar to that of *amœnum*, but the periphery has two broad, elegantly articulated ribs, separated by a sharp groove, and the base with six or seven sharp spiral grooves, with the interspaces of the first four articulated and wider, and those outside of them gradually narrower toward the margin; the umbilicus is, like that of *amœnum*, excavated, but with strong transverse wrinkles. A shell of six whorls beside the nucleus measures: alt. 5.0; max. diam. 8.5 mm. It sometimes attains a larger size. It is from the Claiborne Sands.

S. textilinum n. s. (pl. 22, figs. 1, 2, 3), from the Wahtubbee, is a moderately-sized, rather depressed shell of seven whorls beside the sunken nucleus; in front of the suture is a rather broad tubercular or fluctuated elevated band, more than half way to the periphery is another a little less in size, and the peripheral keel is a still smaller thread of the same kind; between the first two are four small threads, and between the second and the keel are several extremely fine grooves; all these are crossed by obliquely radial, close-set, deep, narrow grooves; the periphery is rather high on the whorl; the umbilical rib is broad, rope-like, with sharp oblique ridges across it; outside of the narrow umbilical sulcus three very fine and three broad articulated spirals alternate, then three fine ones, followed by a very elevated, fluctuated thread, between which and the peripheral keel are four or more very fine threads; all the small threads are cut by radial grooves like those on the upper surface; the umbilicus is small, its wall deeply excavated; the aperture but for the sculpture would be rounded, the end of the umbilical rib is very deeply grooved. Alt. 6.5; diam. of shell 12.0; of umbilicus 2.0 mm. This is one of the most elegant shells of our Tertiary, and most nearly related to the Miocene *S. nuperum*, which is known by its rounded whorls, nearly channelled suture with a thick cord in front of it, and uniformly sculptured surface, with the peripheral keel nearly obsolete in the adult, so far as rising above the other sculpture is concerned.

Finally we close our list with the well-known *S. granulatum* Lam., which is the *S. perspectiva*, T. and H. *non* Linné, which has existed since later Miocene times. The fossil specimens are rather more granulose than the recent ones, as in the case of the Nassas, but this is hardly pronounced enough to be dignified by a varietal name, and even Conrad refrained from baptizing it. The Jamaica Miocene variety *quadriseriatum* Sby. is slightly more flattened above the periphery than the type.

Solarium granulatum Lamarck.

S. granulatum Lam., An. s. Vert. vii. p. 3, 1822; Encyc. Method., pl. 446, fig. 5 a–b, 1792. Not *Solarium granulatum* Lea, Contr. Geol., p. 122, pl. 4, fig. 111, = *Solariella* sp.
S. quadriseriatum Sowerby, Quart. Journ. Geol. Soc. vi. p. 51, pl. 10, fig. 8, 1850.
Architectonica perspectiva Tuomey and Holmes, Pleioc. Fos. S. Car., p. 120, pl. 26, fig. 6, 1857; not of Linné or Lamarck.
Solarium sexlineare Nelson, Trans. Conn. Acad. ii. p. 11, pl. vi. fig. 11, 1870; Pliocene? Peru.

Older Miocene of the Chipola beds, Florida, Burns; of Santo Domingo, Sowerby; Chesapeake Miocene of Duplin Co., N. C., Burns; newer Miocene of the Cape Fear River, N. C., Johnson; and of South Carolina at Darlington, Holmes; Pliocene of Costa Rica, Gabb; Post-Pliocene of South Carolina at Simmons's Bluff, Burns; living off the coast of the United States from Cape Hatteras to the West Indies and Texas, in rather deep water.

The North Carolina fossil exactly resembles the recent shell unless the granulations are slightly more prominent in the former, a character which is not constant within the species. Those from Chipola are all small specimens, but agree perfectly with the younger *granulatum* except in having the periphery and basal ribs conspicuously beaded. They may form a variety *chipolanum*.

Solarium nuperum Conrad.

Solarium nuperum Conr., Journ. Acad. Nat. Sci. Phila. vii. p. 141, 1834. Suffolk, Va, Miocene.
Architectonica nuperum Conr., Am. Journ. Conch. iii. p. 260, pl. 19, fig. 8, 1867.

Older Miocene of the Chipola beds, Calhoun Co., Florida, Burns; Chesapeake Miocene of Yorktown, Va., Harris.

This very well marked species is rather widely distributed, and is the precursor of the Pliocene and recent deep-water *S. bisulcatum* Orb. (*S. boreale* Verrill) of our Southeastern and the Antillean coasts. The young are slightly carinated, a character which with greater maturity is effaced.

Very close to this species by the figure and description is the so-called *S. Hargeri* Meyer, a name applied to some minute very young specimens of this genus (Bull. Geol. Surv. Ala. i. p. 67, pl. 2, figs. 23, 23 a–b, 1886) from the Red Bluff Eocene. A specimen received by the National Museum and named by the author is a very young specimen of *S. triliratum* Conrad, but the original type of Meyer in the Aldrich collection is without doubt, as De Gregorio had already surmised, a very young specimen of *S. elaboratum* Conrad

It is rather dangerous to devote time to the description of minute fragments, tips of shells, and specimens in their larval condition or near it, unless one is familiar with the younger stages of the forms already known. Dr. Meyer would have less to regret in the matter of synonyms if he had familiarized himself more thoroughly with the mature forms before describing the minutiæ which are largely made up of their early stages.

Solarium amphitermum n. s.

Plate 22, figures 16, 16 a.

Older Miocene of Greensboro', Caroline Co., Maryland, Harris.

Shell moderately elevated, large, solid, with a blunt periphery and about seven whorls; nucleus sinistral, overturned and immersed in the succeeding coil; upper surface with a transverse sculpture of regularly spaced, impressed lines in harmony with the flexuous lines of growth; periphery marked by a strong, broad, blunt rib cut by the impressed lines so as to carry squarish nodulations. This is separated from a similar but less pronounced rib behind by a deep, very narrow groove; the surface hence to the suture may have one or two fine obsolete spiral raised lines, or may show merely the transverse impressed lines which sometimes gather at the appressed suture; base flattened, inside the rounded edge of the peripheral rib is a small beaded spiral; umbilicus small, bordered by a stout rib with about twelve denticles, outside of which is a smaller, undulated, flattish rib with a deep, narrow groove on each side; between this and the peripheral cord the surface is nearly smooth, or with a few fine obsolete raised lines transversely sculptured with impressed radiating lines strongest near the umbilicus; aperture subquadrate, wider than high, the end of the umbilical rib, when perfect, grooved and guttered. Max. diam. of shell 18.5; of umbilicus 5.0; alt. of shell 10.0 mm.

This fine shell recalls *S. triliratum* Conrad, from the Vicksburg Eocene, which is smaller and more reticulated, beside differing in details of sculpture; *S. trilineatum* Conrad, from the older Miocene of Maryland, is also smaller, proportionately more elevated and has a sharp periphery. *S. granulatum* is without the nearly smooth, broad band between the sutural and peripheral sculpture.

Before leaving this genus, it may be noted that I have not been able to reconcile De Gregorio's figure of *S. elaboratum* with any adult specimen of the species I have seen, nor with his diagnosis; this may be due to defects in the figure, which appears to represent a very young shell much magnified; *S. cælatura* Conr., which De Gregorio refers to *elaboratum* as a synonym, is one of the mutations of *S. bellastriatum*. *S. semidecussatum* Guppy (Geol. Mag. 1874, p. 438) is probably a *Solariella*, but neither figure nor description is sufficient to identify even the genus. *Architectonica Veatchii* and *inornata* of Gabb, from the Chico upper Cretaceous of California, do not belong to the *Solariidæ*, but should be referred to the *Trochidæ*. *S. antrosum* Conr. has not been figured, properly described or recognized since 1833; *S. syrtalis* Conr. is a mere catalogue name never validated by description or figure; *S. striato-granulatum* of Heilprin has been referred by Meyer to *S. elaboratum*, but I have not examined the type; *S. supravenustum* De Gregorio has the aspect, from his figure, of a *Torinia*, or at all events is not a typical *Solarium*. *S. stalagmium* Conr. (Nov., 1833, + *S. elegans* Lea, Dec., 1833, + *S. perinum* De Gregorio, 1890) is a variable and beautiful species of *Solariella*, of which

Aldrich has described a var. *modesta.* I am not sure that *S. cancellatum* Conr. and *S. cancellatum* Lea are one and the same species, but both belong to the genus *Solariella*, and Conrad's name has four months priority. *S. exacuum* Conr. (Nov., 1833, + *Delphinula plana* Lea + *S. delphinuloides* Meyer) is an *Adeorbis*, and will be further referred to under that genus. *S. granulatum* Lea, *non* Lam., is not a *Solarium*, and, under the name *tricostatum* proposed for it by Conrad, should probably be included in the genus *Liotia. S. delphinuloides* Heilprin (Proc. Acad. Nat. Sci. Phila. 1880, p. 375, pl. 20, fig. 13), not of Orbigny (Moll. Cuba, ii. p. 67, 1842), nor of Meyer (1887), appears to be one of the mutations of *S. ornatum.* From the Miocene, with the exception of those already spoken of as belonging to it, only *S. trilineatum* Conrad is known.

Genus **DISCOHELIX** Dunker?

Omalaxis (*pars*) Dall, Rep. Blake Gastr., p. 276, 1889, not of Tryon or Deshayes.
Orbis Lea, Contr. Geol. 1833, not of Lacepède, 1798, nor Philippi, 1836.

Solarium bifrons Lamarck, upon which the genus *Omalaxis* (+ *Bifrontia*) was founded, is different conchologically from such species as *Orbis rotella* Lea, *Omalaxis nobilis* Verrill, etc. Dr. Fischer has found that *Bifrontia zanclæa* Phil. has a *Torinia*-like operculum, and has therefore proposed for it the sub-generic name of *Pseudomalaxis.* The shell of *P. zanclæa* agrees in every respect with that of Lea's *Orbis rotella* and Verrill's *Omalaxis nobilis*, so far as its structure is concerned, but, in the latter, Prof. Verrill found the operculum thin, multispiral, concave externally—in short, like that of a Trochid. Now, it is eminently probable, in this as in other cases, that the American species march together, and we might regard them rather as related to *O. nobilis* than to the Mediterranean form. Dunker's *Discohelix* was founded on a fossil of the Lias, extremely similar to *Orbis* Lea, and of which we cannot hope to know much more that will definitely settle its position. There would seem to be no good reason why we should not accept the name for the fossil forms of which we cannot know the operculum. The probability is that *Discohelix* was like its compatriot *P. zanclæa*, and not like the American forms, but this cannot be positively determined. At most it will be advisable to put the latter in a section of *Discohelix*, which might be called *Discosolis*, with *D. nobilis* as type, and refer to this all our American species. If it should eventually prove that our species are distinguished from the European forms by tangible characters visible in the shell, the sectional name might be promoted to sub-generic rank.

This group has been referred by De Gregorio to *Cyclogyra* Wood, which is founded on a non-molluscan argillaceous test, perhaps a Rhizopod. *Ophileta* Vanuxem is a Silurian form, probably a worm-tube; neither has any relation to the present type, nor to *Skenea.*

The only species known from our Eocene is *Discohelix rotella* Lea, of which *Cyclogyra tipa* De Gregorio is perhaps a fragment of a very large specimen, judging from the figure and description. Two recent species, *D. nobilis* Verrill and *D. lamellifera* Dall, are known from deep water off our Southeastern coast.

It may be noted here that an examination of the type-specimen of *Planaria nitens* Lea, which has been referred to many genera and has often been associated with his *Orbis*, left the impression on my mind that it was allied to *Oxygyrus* or *Atlanta* and was a pelagic shell, but Aldrich with much plausibility has regarded it as the larval shell of a *Solarium*.

Section *Discosolis* Dall.

Discohelix retifera n. s.

Plate 19, figures 1, 1 b, 1 c.

Pliocene of the Caloosahatchie, Dall.

Shell with a smooth sinistral, inverted nucleus and three subsequent sculptured whorls; upper surface flattened, with a prominent beaded cord on each side of the slightly channelled suture, that one in front of the suture the more prominent of the pair; between them are three smaller simple spiral elevated threads, the whole crossed by numerous oblique, elevated, radiating ridges with equal or wider interspaces, which continue over the periphery and base to the umbilical rib; periphery formed by a third prominent cord, which is buried in the suture, while another marginates the base, between which are four smaller ones; between the basal cord and the umbilical rib are two small spirals, the whole reticulated by the transverse sculpture; umbilical rib strong, coarsely annulate or nodose; sides inclined toward the umbilicus; base somewhat excavated; umbilicus large, scalar; aperture quadrate, with a thin edge somewhat reflecting the sculpture and grooved at the end of the umbilical rib. Max. diam of shell 4.5; min. do. 3.0; alt. 1.3 mm.

A single specimen of this elegant little shell was obtained from the marl. Its upper surface recalls *S. ammonites* Lam., from the Paris basin, but the details of its sculpture are quite different.

FAMILY VIVIPARIDÆ.

Genus **VIVIPARA** (Martini) Lamarck.

Historical Synonymy.

Cochlea vivipara fasciata Lister, Hist. An. ii. pl. 126, fig. 26, 1675; *Ibid.*, Exerc. Anat. ii. pl. 2, fig. 17; Conch., t. 1055, f. 6.

Cochlea sp. Linné, Faun. Suec., p. 375, 1746.

Cochlea vivipara Swammerdam, Bibel der Nat., p. 78, pl. ix. figs. 3, 4, 1752.

La vivipare Geoffroy, Traite som. Coq. Paris, p. 110, pl. 3, f. 2. 1767.

Binomial Synonymy.

Helix sp. (*vivipara*) Linné, Syst. Nat., Ed. x. pp. 772, 774, 1758.

Vivipara (*fasciata*) Martini, in Geoffroy, ed. Germ., p. 97, 1767.

Turbo sp. Linné, Syst. Nat., Ed. xii. p. 1237, 1767.
Bulimus sp. Scopoli, Intr. Hist. Nat., p. 192, 1777; Poiret, Coq. fluv., p. 45, 1801.
Nerita sp. (*vivipara*) Müller, Verm. ter. et fluv. ii. p. 182, 1774.
Cochlea sp. (*vivipara*) Da Costa, Brit. Conch., p. 81, pl. vi. fig. 2, 1778.
Paludina Bruguière, Enc. Meth. ii. pl. 458, 1798.
Cyclostoma sp. Drap., Hist. Moll. ter. fluv., p. 34, 1805.
Vivipare Lam., Phil. Zool., p. 320, 1809.
Viviparus Montfort, Conch. Syst. ii. p. 246, 1810.
Cyclostoma Cuvier, Mém. sur la Vivipare, Ann. Mus. xi. p. 172, 1811.
Paludine Lamarck, Extr. d'un Cours Zool. du Mus., p. 117, 1812.
Vivipara J. Sowerby, Min. Conch. i. p. 75, 1813.
Paludina Cuvier, Regne Anim. ii. p. 421, 1817; Say, Journ. Acad. Nat. Sci. Phila. i. p. 125, Oct., 1817.
Paludina Lamarck, An. s. Vert. vi. pt. 2, p. 172, 1822.

This genus has had extraordinary vicissitudes in its nomenclature which well illustrate the necessity of caution in making changes in these ancient names without a thorough investigation of all their history. The type has been commonly known on the continent for more than two hundred years by the vernacular name of "la vivipare à bandes," a name derived partly from its color-markings and partly from its viviparous habit. The first technical use of this appellation which I have discovered is in Martini's German translation of Geoffroy's work on the land and fresh-water shells of the vicinity of Paris. Geoffroy was not a binomial writer in the proper sense of the words, though posterior to the introduction of the binomial nomenclature by Linné in 1758. But he proposed several genera which have been universally adopted, and Martini in his index has supplied binomial appellations in several cases where Geoffroy had merely used, for the species under his new genera, a descriptive phrase. One of these cases is *Vivipara fasciata*, of which Martini says in the text, speaking of the group of Nerites under which five genera are assembled: "All these Nerites lay eggs (*oviparæ*); the only genus excepted, which has, therefore, been named 'die lebendig gebährende' (*vivipara*), brings forth living offspring which come from the mother's womb with small shells" already grown. Geoffroy has as the only species under his second genus of Nerites "*Cochlea vivipara fasciata*," which is straightforwardly indexed by Martini as *Vivipara fasciata*. This may be said to establish the name on a firmer foundation than most of the early non-Linnean names of the transition period, 1758–1799, in nomenclature.

Good old Denys de Montfort—who knew no Latin worth mentioning, and by poverty was driven to engrave (fearfully and wonderfully) the illustrations to his Conchology with his own unaccustomed hand—fancied that all that was necessary to make Latin out of a French vernacular name was to add "us" to it. Hence all his genera end in a masculine manner, and it does not seem to have occurred to him, any more than to some more modern writers, that there was any impropriety in making the "bearer of living young" a male. While a believer in the right of a name to stand without modification in the way it was proposed (unless in case of an obvious misprint not due to the author), I should be inclined in the present instance, if it were necessary, to waive that very wholesome rule. However, a careful study of the synonymy above given will show that there is no occasion for discussing Montfort's "misfit" name any further.

If it were not for Martini's name, it is very likely that the name *Bulimus* Scopoli would have to be adopted for this genus. The subject is of sufficient interest to be worth a short discussion here. To begin at the beginning, so far as *Bulimus* is concerned, Adanson in 1757 (Hist. Nat. du Sénégal, p. 5) proposed a "genus" *Le Bulin*, *Bulinus*, choosing this name because, after the death of the animal, its shell floats like a "petite bulle d'air transparent." This creature, as is well known from Adanson's description and figure, is a fresh-water mollusk belonging to the *Limnæidæ* and having two tentacles, with the eyes on the front of the head near their inner bases. Adanson was a good naturalist, but did not adopt the Linnean nomenclature, and his book was published before the tenth edition of the Systema Naturæ, so he is not entitled to be quoted in binomial nomenclature, whatever his merits in other respects—a fact which has been frequently ignored.

In 1777 Johannes Ant. Scopoli, a distinguished naturalist of Prague, published a Latin Introduction to Natural History (pp. 542, 8vo; publisher, W. Gerle), which contains not only the Linnean genera, which he adopted, but a number of new ones due to himself and other naturalists, including Adanson and Klein, several of whose genera are here first brought into harmony with the binomial system of nomenclature. Due credit is given to these authors by Scopoli (*op. cit.* p. 387), who (p. 392) thus defines the genus *Bulimus*, number 64 of his list:

"*Bulimus* Adans. *Testa* univalvis, non umbilicata; apertura ovali. *Molluscum* tentaculis binis, basi appendiculatis; puncto ophthalmoide distincto aut radicali."

He then refers to Swammerdam's Bibel der Natur, tab. ix. fig. 4, which represents *Vivipara fasciata*, or the species so called by Martini, presumably as an illustration of the anatomical characteristics of *Bulimus*. He gives as examples: *Helix* (now *Succinea*) *putris*, *H.* (*Limnæa*) *fragilis* and *stagnalis* and *H.* (now *Bythinia*) *tentaculata*, all Linnean species. He adds that there are not a few other terrestrial species, and that *Pedipes* of Adanson differs from *Bulimus* by having its aperture denticulate.

This is the first publication of *Bulimus*, and is perfectly regular and sufficient in every respect. Nothing is said of *Bulinus* Adanson, and the only reason for supposing that *Bulimus* is a revised form of *Bulinus* lies in the fact that the diagnosis would be applicable to both, and in the similarity of spelling.

The fundamental fact in this connection is that *Bulimus*, by the rules of nomenclature, as well as common sense, cannot be applied to the land pulmonates with four tentacles and distal eyes on the major pair, with which it has so long been associated. For them there are already names enough and to spare, and if *Bulimus* could be dropped altogether no great harm would result; but as a regularly proposed genus, with four or five species mentioned as examples, this cannot be done, unless we regard it as a synonym of *Vivipara* (Geoffroy and) Martini. This, however, seems to be hardly warranted. Of the three genera (as now understood) represented in Scopoli's list of examples, one, *Limnæa*, was separated from *Bulimus* (Bruguière) by Lamarck in 1799. *Succinea* was proposed by Draparnaud, for *Bulimus putris* Scopoli, in 1801. There remains only *Bulimus tentaculata*, for which Gray proposed the genus *Bithinia* or *Bythinia* in 1821. I shall be glad of any suggestions as to how we can avoid retaining Scopoli's name *Bulimus* for the species *Helix tentaculata* Linné.

Vivipara georgiana Lea.

Paludina georgiana Lea, Trans. Am. Phil. Soc. v. p. 116, plate xix. fig. 85, 1837.
Paludina Wareana Shuttleworth in Kuster, Conch. Cabinet, 21, pl. iv. figs. 10, 11 ; Reeve, Conch. Icon., sp. 23.
Vivipara georgiana Binney, L. and F. W. Sh. N. Am. iii. p. 27, figs. 49–51, 1865.

Caloosahatchie beds, abundant, especially in the upper layers ; widely distributed also in the Post-Pliocene of Florida, and living in the lakes and swamps at the present day in Florida, Georgia, Mississippi and Alabama.

The specimens in the Pliocene agree perfectly with the recent forms and run through just about such a series of variations. I have not seen any Pliocene specimens which retain the color-bands or traces of them. Mr. Pilsbry has described some remarkable malformations which are exhibited by specimens of this species from a mound in the vicinity of Lake George, Florida, under the name of variety *altior.* They are due without doubt to the direct physiological action of some obnoxious substance, such as salt, sulphur, etc., in the water in which they lived.

Turbo glaber H .C. Lea, from the Miocene of Petersburg, Va., is a *Vivipara.* The type-specimen, now in the National Museum, is in poor condition, but there can be no doubt as to the genus of the shell. Perhaps further exploration will reveal specimens in better condition which may be compared with other known species.

FAMILY AMPULLARIIDÆ.

Genus **AMPULLARIA** Lamarck.

Subgenus **Pomus** (Humphrey).

Ampullaria (Pomus) hopetonensis Lea.

A. hopetonensis Lea, Trans. Am. Phil. Soc. v. p. 115, pl. xix. fig. 84, 1837.

Pliocene of the Caloosahatchie beds, Willcox; Post-Pliocene of Georgia, Florida and Alabama; living at Darien, Georgia, Lea.

The specimens agree exactly with Lea's type of *hopetonensis*, which has

Grand Gulf beds at Vernal, Green County, Miss., in October, 1889, by Mr. L. C. Johnson, of the U. S. Geological Survey. The depth at which the same bed was found near the coast at Mobile indicates a seaward dip of about twenty-five feet to the mile, which is in accordance with the result deduced from observations on other beds in the same general region by Hilgard, Smith and other geologists.

Genus **BYTHINELLA** Moquin Tandon.

Bythinella Nickliniana Lea, var. **attenuata** Haldeman.

Plate 21, figure 19.

Paludina Nickliniana Lea, Trans. Am. Phil. Soc. vi. p. 92, pl. xxiii. fig. 109, 1839.
Bythinella Nickliniana Binney, L. and F. W. Sh. N. Am., part 3, p. 68, fig. 134, 1865.
Amnicola attenuata Haldeman, Wrapper of Mon., part 4, p. 3, 1842; Mon., p. 22, pl. i. fig. 13, 1844.
Annicola elongata Haldeman, *op. cit.* on plate.
Bythinella attenuata Binney, *op. cit.* p. 68, fig. 132, 1865.

Pliocene of the Caloosahatchie beds and Shell Creek, Florida, Dall and Willcox; living in the fresh-water streams of Virginia, Pennsylvania and New York, and probably most of the Southeastern States.

The specimen figured is of the elongate variety, but others found varied from that to the typical *Nickliniana*, so that there can be no doubt Mr. Pilsbry is quite justified in uniting the two under one species.

Genus **AMNICOLA** Gould and Haldeman.

Amnicola floridana Frauenfeld, var. **convexa** Pilsbry.

Amnicola floridana Frauenfeld, Verh. K. K. Zool. Bot. Ges., Wien, April, 1863, p. 1028, and 1865, p. 529, pl. x. fig. 4, a-b.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; living in the fresh waters of Florida at the present time.

"Shell turbinate-conic, with narrow conical spire, rather obtuse apex, and deep sutures; whorls nearly five, very convex, lightly marked with irregular incremental lines, aperture ovate, slightly narrower behind, but not angular; peristome continuous, the outer lip often somewhat expanded; the inner lip less curved than the outer one, and either free or in contact with the body-whorl above; umbilicus large and conspicuous. Several specimens give the following measurements: Alt. 3.5–3.5; diam. 2.3–2.4; alt. of aperture 1.4–1.7 mm.

"Differs markedly from *A. floridana* in the narrow spire, deep sutures, wider umbilicus, and less attached peristome; but as the specimens are very variable, and as the differential characters mentioned are precisely those commonly found in *degenerate Amnicolidæ* the world over, not much dependence can be placed upon them." [H. A. P.]

Amnicola omphalotropis Pilsbry, n. s.

Plate 21, figure 13.

Pliocene marls of the Caloosahatchie and Myakka Rivers, Florida, Dall and Willcox.

"Shell globose-turbinate, composed of four very convex whorls; smooth except for almost imperceptible lines of growth; apex obtuse; suture very deeply impressed between the last two whorls; aperture round-ovate, very little higher than wide; scarcely angulate above; peristome thin, continuous, in contact with the body-whorl above the umbilicus; columellar lip not expanded or reflected, excavated and concave; umbilicus rather narrow, conspicuously excavated and bounded by an elevated carina. Alt. of two specimens, A, 2.5; B, 3.0; diam. A, 2.0; B, 2.2 mm.

"I have seen but two specimens of this species, which is one of the most distinct known to me in the peculiarly carinated umbilicus and the inner lip, which is so excavated that it lies behind the plane of the outer lip." [H. A. P.]

After the types were returned by Mr. Pilsbry and the duplicate material scrutinized in the light of his identifications, several other specimens were found, including one from the Upper Pliocene of the Myakka River. All agree very well in the characters assigned to the species, though the umbilicus differs somewhat in size.

SUBFAMILY RISSOINÆ.

Genus **RISSOA** Fréminville.

Subgenus **Rissoa** s. s.

Rissoa lipeus n. s.

Plate 20, figure 8 b.

Pliocene marl of the Caloosahatchie, one specimen, Dall; living in the lagoon at Watling Island, Bahamas, Dr. Brown.

Shell small, plump, with a rather obtuse apex and four and a half inflated whorls; apical whorls smooth, later ones sculptured with two fine, elevated spiral lines with wider interspaces at the periphery and five or six more on the rounded base, becoming somewhat more adjacent toward the pillar; these are crossed by numerous fine, elevated, rather distant threads, beginning at the suture and becoming obsolete after passing over the periphery; aperture rounded, slightly interrupted by the curve of the body; margin slightly thickened, pillar-lip arched, with no umbilical chink behind it; edge of the aperture not oblique or sinuous. Alt. 1.3; max. diam. 0.8 mm.

The recent specimen is translucent, and differs only by having one or two more elevated lines between the periphery and the suture on the last whorl.

Rissoa athymorhyssa n. s.

Plate 20, figure 13 b.

Pliocene of Shell Creek, Florida, Willcox.

Shell small, oblong, with a little more than four and a half rounded whorls, slightly angulated at the shoulder and constricted just in front of the appressed suture; surface without perceptible spiral sculpture, apical whorls smooth, the last two whorls marked by regular low, somewhat flattened, transverse wrinkles, with narrower interspaces, which become obsolete on the base; aperture ovate, edge simple, continued over the body by a thin callus; pillar thin, arched; base imperforate. Alt. 2.5; max. diam. 1.2 mm.

Only a single specimen was obtained.

Subgenus **Onoba** Adams.

Rissoa (Onoba) geræa n. s.

Plate 21, figure 13 a.

Newer Miocene of the Cape Fear River, N. C., at Mrs. Purdy's marl-bed, Johnson.

Shell thin, subovate, with a subacute apex and five or six gently-rounded whorls; suture distinct, but not deep; apical whorl very minute, smooth; subsequent whorls evenly spirally striated, with the interspaces slightly wider than the striæ, the latter a little more distant and slightly coarser on the base, especially near the umbilical region; the striæ increase by intercalation, and hence appear alternate here and there; base produced; aperture ovate, angular behind, the inner lip a little concavely flexuous, reflected against the body, producing a more or less conspicuous chink, but with no perforation behind it; margin in the fully adult obtuse and internally thickened, continuous over the body; in the young the anterior end of the reflected pillar-lip projects slightly; in the adult this projection is hidden by the lip-deposit. Alt. 4.5; max. diam. 2.5 mm.

Rissoa (Onoba) geræa var. **minor** Dall.

Shell slightly smaller, and with slightly finer sculpture; the umbilical chink less wide or even obsolete. Alt. 3.5; diam. 1.75 mm.

Pliocene of the Caloosahatchie beds, Dall.

These shells are so much alike, in spite of the difference in size, that I hesitate to separate them even varietally, but it is probably best to keep the differences in mind, since, from the material I have been able to examine, they would appear to be characteristic of the older and newer horizons. It may be, however, that more material will show them to intergrade. The specimen figured is from the Miocene.

Rissoa (Onoba) callistrophia n. s.

Plate 21, figure 14 a.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox.

Shell elongate, slender, loosely and somewhat irregularly coiled, with seven rounded whorls; nuclear whorl very minute, smooth, the remainder with close-set, somewhat alternated, fine revolving flat threads, covering the whole surface; whorls somewhat shouldered, spire subacute; base rounded, aperture small, angular behind, rounded in front, continuous, though thin, over the body; pillar-lip reflected, forming a minute chink, but not a perforation; margin thin, obtuse. Alt. specimen A, 4.6; B, 4.75; max diam. A, 1.9; B, 1.8 mm.

The loose coiling of this shell gives rise to obvious differences of appearance. It is related to *R.* (*Onoba*) *aculeus* Gould, but is larger, less pupiform, with less regular striation and a proportionately much smaller mouth.

Rissoa (Onoba) microcharia n. s.

Plate 20, figure 8 a.

Pliocene of the Caloosahatchie, Dall.

Shell very minute, with four rounded whorls; nucleus inflated, polished, remaining whorls smooth or marked only by faint incremental lines, gently rounded; suture distinct; base produced, aperture subovate, angular behind; the margin thin, continuous, slightly reflected on the pillar, making an almost invisible chink. Alt. of shell 1.12; max. diam. 0.6 mm.

This is one of the most minute species known. It has much the form of *R. aculeus*, but is without spiral sculpture; the inflated nucleus at first suggests that the shell is immature, but the other characters indicate maturity. At any rate, it is not the young of any species now known from the Pliocene marls.

To conclude our observations on this genus, I may remark that Gabb reports *Rissoa Auberiana* Orb., from the Pliocene of Costa Rica; the Claibornian *Pasithea sulcata* of Lea is a Rissoid with spiral sculpture recalling *Onoba; Pasithea cancellata* H. C. Lea is a young *Tuba,* as the type-specimen shows, though De Gregorio has referred it to *Rissoa;* the *Littorina fervens* of the last-mentioned author seems to me to belong rather in the genus Rissoa; it comes from the Claibornian, from which De Gregorio has also described a *Rissoa* (*Alvania*) *ziga. Rissoa* (*Cingula*) *minuta* Gould and *R. obsoleta* S. Wood are reported by Dawson from the Post-Pliocene of Montreal, Canada.

Genus **RISSOINA** Orbigny.

So far, this genus has been hardly known from American Tertiaries. *R. plicato-varicosa* Heilprin, of the Claibornian, is an *Alaba,* and the only other species I have found described from the United States is *R. mississippiensis* Meyer, from the Jacksonian. *Cerithidea minuta* Gabb, of the Santo Domingo Miocene, turns out, on an inspection of the type, to be a *Rissoina*. It has not been figured, and there is another *Rissoina minuta* from Ceylon described by Nevill. Meyer's *R. mississippiensis* seems to be a good species of the *decussata* type, small and blunt-tipped, owing to the peculiar planorboid growth of the nuclear whorls.

Rissoina sp. indet.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Dall.

A specimen comprising the last two whorls of a species of *Rissoina* resembling *R. lævigata* Adams is all that is known. It is very much larger than *R. lævigata* and quite smooth. It measures 4 mm. long and 2.5 mm. wide. As indicating the presence of the genus in this bed, its occurrence is recorded here.

Rissoina Johnsoni n. s.

Plate 20, figure 1.

Newer Miocene of the Cape Fear River, N. C., C. W. Johnson.

Shell subconic, polished, not sculptured, with a rounded, plump nucleus of a single whorl and seven subsequent whorls; sides of the spire flattened, suture distinct, not impressed, sculpture only of extremely fine lines of growth; the last half of the last whorl is somewhat constricted, so that the posterior edge of the suture overhangs a little; periphery of last whorl bluntly angular, base produced; margin of the aperture continuous, thickened, smooth; the outer lip patulous, within showing an obscure ridge near the posterior commissure. Lon. 5; max. diam. 2 mm.

This pretty species is distinguished by its short, blunt nucleus of a single whorl, its larger size and more conspicuously contracted last whorl, from *R. lævigata* and the other smooth species of *Rissoina* so far described.

Rissoina lævigata Adams.

Rissoa lævigata C. B. Ads., Contr. Conch., p. 114, 1850.
Rissoina lævigata Schwartz, Mon. Rissoina, p. 111, fig. 79, 1860.

Older Miocene of the Chipola beds, Calhoun County, Florida, Burns; Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox; living from Cape Hatteras, N. C., to the Antilles, and also in the Indo-Pacific region, according to Schwartz.

The specimens have been compared with types named by Prof. Adams, and offer no distinctive characters whatever. The nucleus is peculiar, being of several whorls, shaped like a little *Vertigo*, which at once differentiates it from the preceding species.

Rissoina Chesneli Michaud.

Rissoa Chesneli Michaud, Descr. Coq. Nouv., p. 17, 1832.
Rissoina Catesbyana Orbigny, Moll. Cuba, ii. p. 24, pl. 2, figs. 1, 3, 1842.
Rissoa scalarella C. B. Ads., Proc. Boston Soc. N. Hist. ii. p. 6, 1845.
Rissoina Chesneli Schwartz, Mon. Rissoina, p. 73, figs. 38, 39, 1860.

Pliocene of the Caloosahatchie beds, Dall; living from Cape Hatteras, N. C., to the Antilles and Mauritius and, according to Jeffreys, in the Mediterranean.

The fossils have been compared with authentic specimens.

Rissoina chipolana n. s.

Plate 22, figure 20.

Older Miocene of the Chipola beds, Calhoun County, Florida, Burns.

Shell slender, acute, with a minute nucleus of two and a half smooth whorls, followed by seven subsequent whorls; whorls slightly rounded, suture appressed; transverse sculpture of sixteen to twenty narrow, rounded, slightly flexuous ribs, usually with about equal interspaces, which completely cross the whorls; spiral sculpture of fine striæ, generally confined to the base of the shell, but sometimes extending over the whole surface; aperture semicircular; lip thickened and varicose, produced at the middle, receding at the base of the pillar and at the posterior commissure, basal fasciole obscure, slightly tumid, interior of aperture smooth and simple. Lon. of shell 6; max. diam. 2.5 mm.

The average size is smaller than that above given. The nearest species to this is the *R. triangularis* Watson, a recent Australian species. The *R. mississippiensis* Meyer has some characters in common, but is smaller and has a much blunter apex; on the whole, this is a very distinct species.

Rissoina cancellata Philippi.

Rissoina cancellata Philippi, Zeitschr. f. Mal. 1847, p. 127.
Rissoa pulchra C. B. Ads., Contr. Conch., p. 14, 1850.

Pliocene of the Caloosahatchie beds, Florida, Dall; living in the Florida Keys, the Antilles, on the west coast of South America and in the Indo-Pacific region.

Rissoina decussata Montagu.

Helix decussata Mont., Test. Brit., p. 399, 1803.
Rissoa striatula Andr., Bull. Soc. Géol. de France, p. 321, 1835.
Rissoina striato-costata Orb., Moll. Cuba, pl. 12, figs. 30, 32, 1842.
Rissoa striosa C. B. Ads., Contr. Conch., p. 116, 1850.
Rissoa Janus C. B. Ads., Panama Shells, p. 538, 1852.
Rissoina decussata Schwartz, Mon. Rissoina, p. 80, fig. 12.

Older Miocene of the Chipola beds, Calhoun County, Florida, Burns; Miocene of France, Italy and the Vienna basin; Pliocene of the Caloosahatchie beds and of Italy; living in the Antilles, the Mediterranean, at Panama, and in the Indo-Pacific region.

The full synonymy of this ancient and widely spread species will be found in the monograph of Schwartz von Mohrenstein above cited. The Caloosahatchie form differs slightly from the type, being proportionately wider, with the whorls flatter, the sculpture less sharply defined and tending to become obsolete; the shell is also somewhat larger, and may constitute a variety *planata*. It measures 8.3 mm. long and about 3 mm. wide.

FAMILY ADEORBIDÆ.

Genus **ADEORBIS** S. Wood.

This genus has recently been shown by Verrill to be related to the *Rissoidæ* more nearly than to the similarly formed *Trochidæ*, which have usually been associated with *Adeorbis*. The form of the spire is rarely a family character; but, taking all things into consideration, I proposed in 1889 to separate *Adeorbis* and its allies in a family by themselves. The group is quite ancient. The *Adeorbis exacua* Conrad (as *Solarium*, + *Delphinula plana* Lea) is only to be discriminated from *A. Beaui* Fischer, of the present fauna of Florida and the Antilles, by the fact that, in the fossil, the basal carina forms the periphery, while in the recent shell it is contracted to a smaller radius than the next anterior carina.

Adeorbis supranitidus S. Wood.

Typical Form.

Adeorbis supranitidus Wood, Cat. 1842, Crag Moll., p. 137, pl. xv. figs. 5 a, 5 b, 1848.
Skenea trilix Bush, Trans. Conn. Acad. vi. p. 464, pl. xiv. fig. 7, 1885.

Var. Orbignyi Fischer.

Adeorbis Orbignyi Fischer, Journ. de Conchyl. vi. pp. 173, 286, 1857.
Omalaxis ? lirata Verrill, Trans. Conn. Acad. v. p. 529, 1882.
Skenea lirata Verrill, *op. cit.* vi. p. 452; Bush, vi. p. 464, 1885.
Adeorbis supranitidus var. *Orbignyi* Dall, Blake Gastr., p. 278, 1889.

Older Miocene of Santo Domingo, Gabb, and of the Chipola beds, Calhoun County, Florida, Burns; Chesapeake Miocene of St. Mary's, Md., Willcox, and of the Natural Well, Duplin County, N. C., Burns; Newer Miocene of Cape Fear River, N. C., Johnson; Pliocene of continental Europe and of Britain, also in the Waccamaw beds of South Carolina, at Tilly's Lake, Johnson; living on the coast of the Eastern United States from Cape Cod southward, and widely distributed on the opposite shores of the Atlantic.

For variations in this species consult the Blake Report, p. 278; similar variations are found with the type-form from the early Miocene.

There is much probability that *Adeorbis infracarinata* Gabb (Journ. Acad. Nat. Sci. viii. p. 365, pl. 46, fig. 62, 1875), *Vitrinella truncata* Gabb (*op. cit.* p. 367, pl. 47, f. 65), from the Pliocene clays of Costa Rica, and *V. pentagona*

Gabb (*op. cit.* p. 368, pl. 47, fig. 68), from Santo Domingo, are merely very young examples of varieties of this species. *Vitrinella marginata* Guppy, from the Pliocene of Trinidad, with which Gabb compares one of his shells, is too badly figured to be identified, but may be an *Adeorbis*, though the figure looks more like a *Solariorbis*, and does not agree with the description.

Adeorbis Beaui Fischer.

Adeorbis Beaui Fischer, Journal de Conchyl. vi. p. 286, pl. 10, fig. 12, 1857.
Cyclostrema bicarinatum Guppy, Quart. Journ. Geol. Soc. xxii. p. 291, pl. xvii. figs. 5 a, 5 b, 1866.

Older Miocene of Jamaica (Guppy) and of Santo Domingo (Gabb); living from Florida to Guadelupe, West Indies. This species has not been reported from our southern Tertiaries, but can hardly fail to exist there, and should be searched for. It is a repetition of the preceding species on a very much larger scale.

Adeorbis obliquistriatus H. C. Lea.

Delphinula obliquistriata H. C. Lea, Trans. Am. Phil. Soc., 2d Ser. ix. p. 261 (extra copies p. 35), pl. 36, fig. 72, 1845.

Chesapeake Miocene of Petersburg, Va., Lea.

This little shell has somewhat the aspect of a *Mölleria*, but should perhaps be referred to *Adeorbis*.

Adeorbis strigillatus n. s.

Plate 19, figures 10, 10 b.

Pliocene of the Caloosahatchie beds; Dall.

Shell small, flattened, of four whorls; nucleus extremely minute, smooth; spire depressed; suture distinct, not channelled; the whorl excavated spirally, parallel with and close to the suture; periphery keeled; the top of the whorl between the periphery and the channel next the suture rounded, rather prominent; upper surface of the whorls variable, from smooth to strongly radiately ribbed with flexuous costæ; base flattish, with two strong spiral keels and one at the margin of the umbilicus; between these keels narrow, flexuous, elevated threads radiate from the umbilical margin, but do not crenulate the keels, and vary in strength with different individuals, though never quite obsolete; in the interspaces between the keels there are sometimes one or two fine intercalary spirals; umbilicus deep, subcylindrical, with smooth sides; aperture rounded, the outline modified by the keels, a slight callus on the pillar lip, otherwise the edge is sharp and simple. Alt. 1.0; max. diam. 2.0 mm.

This little shell belongs to the group of *A. subcarinatus*, and, in spite of the variability which we have referred to, manages to preserve a very recognizable individuality.

Adeorbis concavus H. C. Lea.

Delphinula concava H. C. Lea, Trans. Am. Phil. Soc., 2d Ser. ix. p. 261, pl. 36, fig. 70, 1845.

Delphinula lipara Meyer, Proc. Am. Phil. Soc. xxv. p. 137, not of H. C. Lea.

Chesapeake Miocene of Petersburg, Va., Lea, and of Duplin Co., N. C., near the Natural Well, Burns; Newer Miocene of the Cape Fear River at Mrs. Guion's marl-bed, Johnson; Pliocene of the Caloosahatchie beds, Florida, Dall.

This species resembles the next, but may be distinguished from it by its more polished and shining surface, flatter spire, greater extent of the aperture applied to the body, and slightly more angulate periphery. Meyer unites this species to *A. lipara* Lea, but they seem to me sufficiently distinct.

Adeorbis Holmesii Dall.

Cochliolepis parasiticus Holmes, Post-Pleioc. Fos. S. C., pl. xiv. figs. 9, 9 a, 9 b, 1860; not of Stimpson.

Vitrinella Holmesii Dall, Rep. Blake Gastr., pp. 360, 392, 1889.

Newer Miocene of Duplin County, N. C., Burns; Post-Pliocene of Cainhoy, Wando River, S. C., Holmes.

The descriptions of *C. parasitica* and *Adeorbis nautiliformis* appear to be mixed, and the numbers of the figures on the plate are reversed. The figures above cited refer to this species. The species differs from the preceding in the absence of polish on the whorl, in being slightly more striated spirally, in having the suture more impressed, the whorl in front of it slightly concave instead of merely flattened, the periphery more rounded, and the aperture applied to the body-whorl only at its posterior angle, and for a shorter distance. I supposed, from the figure alone, that this might be referable to *Vitrinella*, but the examination of specimens shows that it is probably an *Adeorbis*.

Adeorbis Leai n. s.

Newer Miocene of Duplin County, N. C., Burns.

Shell resembling *A. concavus* Lea, but larger, with a relatively smaller spire, the periphery rounded, the outline of the spire an almost even segment of a circle, not flattened except very slightly in front of and close to the appressed suture. It also differs in being covered all over with very fine, sharp, elevated spiral lines with about equal interspaces, somewhat fainter on the base and stronger again in the umbilicus, which is deep and of about the same relative size as that of *A. concavus*, and the obliquity, form and application to the body-whorl of the aperture are very similar to the same features of *A. concavus*. Whorls more than three (nuclear part lost in the specimen). Alt. of shell 3.5; max. diam. 8.0 mm.

This is a very recognizable species, in which the spire is more infolded and the form fuller, larger and more rounded than in *A. concavus*. The type-specimen is so broken that I prefer to await better material before trying to figure it.

Beside the species previously alluded to, *Delphinula lipara* H. C. Lea (*op. cit.* p. 261, pl. 36, fig. 71, 1845) is, from the type, an *Adeorbis* much like the recent *A. sincera* Dall; *A. nautiliformis* Holmes is a *Cochliolepis* very similar to *C. parasiticus; A. lyra* Conrad is a *Fossarus; A. simplex* Gabb seems to be a good species from the Costa Rica Pliocene; *Adeorbis carinata* Gabb, of the Santo Domingo Miocene, is an *Episcynia* close to *multicarinata* Stm.; *Vitrinella obliquistriata* Gabb is probably identical with the *Delphinula* of the same name described by H. C. Lea; both are referable to *Adeorbis* or *Mölleria; V. crassicosta* Gabb is also probably an *Adeorbis; Adeorbis quadrangularis* Meyer (Senck. Ber. 1886, p. 4, t. 1, fig. 1) is an *Ethalia*, and so is *A. subangulatus*, both from Jackson, Miss., Eocene. *A. lævis* (called *A. brevis* by Gregorio) of the same author (Ala. Geol. Surv., Bull. 1, p. 67, 1886), from Red Bluff Eocene, closely resembles *A. lipara*. *Solarium delphinuloides* Meyer (1887), *non* Heilprin (1880), from the Jacksonian, appears to be synonymous with *Adeorbis exacua* Conrad. In the same publication Meyer refers the *Teinostoma rotula* Heilprin to *Delphinula depressa* Lea as a synonym, and refers the species to *Adeorbis*. I have not compared the types, but it is obvious from Lea's description that the shell is not an *Adeorbis*, but an *Ethalia* or something related to that genus. Aldrich records it from the Bell's Landing and Lisbon horizons in Alabama. De Gregorio figures from the Claibornian a doubtful *A. incertus*, an *A. pignus*, which should be an *Ethalia*, and an *A. punctiformis* (diam. 0.5 mm.) which must be regarded as a doubtful species, if not a *Cæcum* in its planorboid stage. He also proposes a subgenus *Asiolus* for the two species last mentioned, which shares the uncertainty of their characters.

FAMILY ASSIMINIIDÆ.

Genus **ASSIMINEA** Leach.

Assiminea affinis Orbigny.

Paludestrina affinis Orb., Moll. Cuba, ii. p. 8, pl. x. fig. 8, 1842; Dall, Bull. U. S. Nat. Mus. No. 37, p. 150, No. 864, 1889.
Cingula? concinna C. B. Adams, Contr. Conch., p. 70, 1850.

Older Miocene of the Chipola beds, Calhoun County, Fla., Burns; Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox; living in the Florida Keys and the West Indies.

This species is extremely rare in the marls.

Assiminea Auberiana Orbigny.

Paludestrina Auberiana Orb., Moll. Cuba, ii. p. 8, pl. x. figs. 6, 7, 1842; Dall, Proc. U. S. Nat. Mus. vi. p. 335, 1883.
Phasianella concolor C. B. Adams, Contr. Conch., p. 68, 1850.

Pliocene of the Caloosahatchie and Shell Creek; living on the west coast of Florida and in various parts of the Antilles.

This is a more swollen and larger species than the preceding, and somewhat more frequent in its occurrence. The young show an obtuse peripheral angle, but the last whorl of the completely adult shell is quite rounded.

FAMILY TRUNCATELLIDÆ.

Genus **TRUNCATELLA** Risso.

It is somewhat remarkable that this genus, which is widespread in its present distribution in the Antilles and on our Southern coast, and which in Europe is found in faunæ of Eocene age, has not yet turned up from our Pliocene, to say nothing of earlier beds. I note this circumstance in order that future collectors may bear it in mind and, if possible, either find it or confirm its absence.

FAMILY CALYPTRÆIDÆ.

Genus **MITRULARIA** Schumacher.

Calyptræa Lamarck, 1801, not of Lamarck, 1799.

Mitrularia equestris Linné.

Mitrularia equestris (Linné) Dall, Blake, Gastr., p. 283, 1889.

Pliocene of the Caloosahatchie beds, rare, Dall; living on the coast of the United States from Cape Hatteras, N. C., southward to Florida, and in the Antilles.

Genus **CRUCIBULUM** Schumacher.

Section *Crucibulum* s. s.

This section is distinguished from *Dispotæa* Say by having in the adult the whole margin of the internal cup free from the shell, and the cup as a whole merely attached by a narrow strip of adhesion; while in *Dispotæa* a third or half of the cup is formed by the wall of the shell.

Both sections are remarkable for the modifications of external sculpture, due largely to the irregularities of the surface upon which they rest, which are reflected in the form of the margin of the base applied to them, but also to modifications of the surface originated by the animal. The normal sculpture is of radiating riblets, coarse or fine, but these may have a microscopic shagreening, or may be furnished with tubular spines, or small tubercles, all within the species and often on different growth-stages of the same specimen.

The group is known only from the Miocene and later horizons. A *C. antiquum*, described by O. Meyer from the Claibornian, proved when cleaned from the matrix to be a *Balanus*. As originally constituted, *Dispotæa* was a synonym of *Crucibulum*, but has been retained by Conrad, Mörch and the writer, for the species indicated above, in a sectional sense. The species of both groups have been very greatly overstated by naturalists who have assumed the constancy of the surface characters or those due to station.

Crucibulum auricula Gmelin.

Patella auricula Gmelin, Syst. Nat., p. 3694, 1780.

The typical form is rather depressed, with fine radiating, frequently dichotomous lines on the upper surface. It is found in the Pliocene of the Waccamaw beds, S. C., Johnson; of the Caloosahatchie, Shell Creek and the Myakka River, Florida, Dall and Willcox; living on the west coast of Florida and southward to Northern Brazil in 25 to 100 fathoms. Some forms of the West American *C. spinosum* are hardly distinguishable.

Crucibulum auricula var. **costatum** Say.

Dispotæa costata Say, Journ. Acad. Nat. Sci. Phila. iv. p. 132, 1824; Conr., Medial Tert., p. 80, pl. 45, fig. 2; not of Tuomey and Holmes.

Calyptræa pileolus H. C. Lea, Trans. Am. Phil. Soc., 2d Ser. ix. p. 248, pl. 35, fig. 38, 1845; young shell.

C. verrucosum (Rve.) Heilprin, Trans. Wagner Inst. i. p. 103, 1887.

This variety has strong radiating ribs without any fine sculpture on them. It is known from the Miocene of St. Mary's River, Maryland; the Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; and living in the Antilles.

Crucibulum auricula var. **chipolanum** Dall.

Shell with sharply cut radiating threads and riblets, rarely dichotomous, stronger than in the typical form, yet not reaching the strength of the ribs in *C. costatum.* From the Older Miocene of the Chipola River, a mile below Bailey's Ferry, Burns. All the specimens from this horizon appear to have this particular sculpture, which otherwise would hardly have authorized the application to them of even a varietal distinctive name.

Crucibulum auricula var. **imbricatum** Sowerby.

Calyptræa imbricata Sby., Genera, xxiii. fig. 5, 1824.

Dispotæa ramosa Conr., Medial Tert., p. 79, pl. 45, figs. 3, 18, Jan., 1845; Tuomey and Holmes, Pleioc. Fos., p. 108, pl. 25, fig. 5.

Like *C. costatum,* but with fine radiating threads over the ribs, frequently irregular or ramose. From the Chesapeake Miocene of Yorktown, Va., Wilmington, N. C., and Calvert Co., Md.; Pliocene of the Caloosahatchie beds, Dall; living on the coast of West America from Lower California to Panama.

The cup, probably of this form, has been described and figured by Tuomey and Holmes as an independent species under the name of *Hipponyx Bullii,* and Conrad has committed a similar "bull" somewhere in his later writings. He referred *H. Bullii* to the "genus" *Cochlolepas* Klein.

This form, which as a living shell is only known from West America, seems to have been one of those which before the elevation of the isthmus spread to the Pacific, and when changes of level or other reasons exterminated the parent stock these distant colonies (as in the case of *Cumia*) escaped.

This immunity, I believe, is closely connected with the much steeper seaward slope of the Pacific litorale, which would allow a certain proportion of the shore-dwellers to retreat when slow elevation dried off the beaches which were their accustomed haunts. The Pacific *C. imbricatum*, except for the link furnished by the fossils, is quite distinct from its near relative, *C. spinosum*, but in the Pliocene fossils the intermediate forms are more numerous, and there the two can hardly be regarded as distinct species.

Crucibulum auricula var. spinosum Sowerby.

Calyptræa spinosa Sby., Genera, xxiii. figs. 4, 7, 1824.
Crucibulum spinosum Gabb, Geol. Santo Dom., p. 241, 1873.
Dispotæa dumosa Conrad, Am. Journ. Sci. xli. p. 346, pl. 2, fig. 9, 1841; young shell.
Crucibulum dumosum Tuomey and Holmes, Pleioc. Fos. S. Car., p. 109, pl. xxv. fig. 6, 1857; young shell.

Shell with radiating riblets more or less ornamented with tubular spines or tubercles. Fossil in the Older Miocene of Santo Domingo, Gabb; in the Newer Miocene of North and South Carolina, Conrad and Holmes; in the Pliocene of the Caloosahatchie beds and Alligator Creek, Florida, Dall and Willcox; in the Post-Pliocene of California, Conrad; and living from Monterey, California, to Panama on the Pacific Coast.

In the young of this species the cup, especially if a little broken, resembles that of *Dispotæa*, but in the adult its margin is wholly disengaged from the wall of the shell. The Caloosahatchie specimens agree in the minutest particular with recent specimens from California, though both exhibit a wide range of variation.

Section *Dispotæa* (Say) Conrad.

Crucibulum constrictum Conrad.

Dispotæa constricta Conr., Bull. Nat. Inst. ii. p. 194, pl. 1, fig. 2, 1842; Medial Tert., p. 80, pl. 45, fig. 4, 1845.
Crucibulum costata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 107, pl. 25, fig. 4, 1857; not *C. costata* Say.

Older Miocene of Jericho, N. J., and the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Burns and Dall; Chesapeake Miocene of the Choptank River and St. Mary's Co., Md., of the James River, Va., of North Carolina, of Peedee River, S. C., and of the upper bed at Alum Bluff, Chattahoochee River, Florida.

The character for which Conrad named this species was due to an individual distortion, but the species is a good one. It is liable to be mistaken for *C. auricula* var. *costata* Say, from which it differs by the adherent cup in the adult state.

Tuomey and Holmes have figured a fine normal specimen under the name of *costata*. I have not seen this species from the Pliocene.

Crucibulum grande Say.

Calyptræa grandis Say, Journ. Acad. Nat. Sci. Phila. iv. p. 130, pl. 7, fig. 6, 1824.
Crucibulum inerme? Nelson, Trans. Conn. Acad. ii. p. 5, 1870.

? Miocene of Maryland, Say; Chesapeake Miocene of the James River, Va., near Grove's Wharf, Burns; Surrey Co., Va., Conrad.

This splendid species almost frees its cup, but not quite; so that it is placed in this section. *C. inerme* Nelson has not been figured or fully described, but like the present species is smooth externally and has the cup attached to the wall of the shell; it is from the later (Pliocene?) Tertiaries of Peru. It is probable that the type of *C. grande* really came from Virginia and not Maryland.

Crucibulum multilineatum Conrad.

Dispotæa multilineata Conr., Am. Journ. Sci. xli. p. 346, pl. 2, fig. 8, Oct., 1841; Medial Tert., p. 80.
Crucibulum multilineata Tuomey and Holmes, Pleioc. Fos. S. Car., p. 107, pl. 25; fig. 7, 1857.

Newer Chesapeake Miocene of the vicinity of the Natural Well, Duplin Co., N. C., Hodge and Burns.

This species has the variable exterior of *C. auricula*, with an interior resembling that of *C. striatum* Say, except that the cup is compressed and the margin of its free portion bent inward in a way which I have never observed in *C. striatum*, which latter is also very uniform in its striation and shows no tendency to tuberculation or spinosity.

Crucibulum striatum Say.

Calyptræa striata Say, Journ. Acad. Nat. Sci. Phila. v. p. 216, 1826.
Crucibulum striatum Dall, Bull. U. S. Nat. Mus. No. 37, p. 152, No. 873, pl. 50, figs. 27, 28, 1889.

Post-Pliocene of Sankoty Head, Mass., Verrill; living from Nova Scotia to the Florida Keys in from 3 to 190 fathoms, U. S. Fish Commission.

The specimens from the Waccamaw beds (p. 213) were small and had the cup broken away, so at first they were referred to this species; but on further study it seems certain that they should be placed with *C. auricula*. The present species is not known as a fossil prior to the Pleistocene.

The only other species of *Crucibulum* from our area which I have found are *C. piliferum* and *C. subsutum* Guppy, from the Pliocene of Trinidad. The first species is not figured; it is perhaps a variety of *C. auricula spinosum*, while the second appears to be a *Dispotæa* not unlike Conrad's *multilineatum*.

Genus CALYPTRÆA Lamarck.

Calyptræa Lam , Prodrome Nouveau Class., p. 78, 1799, not Lam. 1801. Type *C. chinensis* L.
Trochita Schum., Essai, p. 184, 1817.
Infundibulum Sowerby, Min. Conch. i. pl. 97, 1812. Not of Montfort, Conch. Syst., 1810.
Galerus Humphrey, Mus. Calonnianum, p. 5, 1797; undescribed.
Leptonotis Conrad, 1866 (very young shell).

The surface of the shell in this group varies much as in *Crucibulum*, especially with the Eocene species.

Calyptræa trochiformis Lamarck.

C. trochiformis Lam., Ann. du Mus. v. i. p. 385, pl. 15, fig. 3, 1804; Deshayes, Coq. fos. bas. Paris, ii. p. 30, pl. 4, figs. 1-4, 11-13.
I. echinulatum + *I. spinulosum* + *I. tuberculatum* Sby., Min. Conch. i. pl. 97, figs. 1, 2, 7, 1812.
Infundibulum trochiformis Lea, Contr. Geol., p. 96, pl. 3, fig. 76.
Infundibulum urticosum Conr., Fos. Tert., 1st Ed., No. 3, p. 32, 1833.
Infundibulum trochiformis Conr., Fos. Tert., 2d Ed., p. 46, pl. 16, fig. 18.
Trochita alta Conrad, Wailes's Geol. Miss., p. 289, pl. xv. figs. 3 a, 3 b, 1854; Proc. Acad. Nat. Sci. Phila., 1855, p. 259.
Infundibulum perarmatum Conr., Proc. Acad. Nat. Sci. Phila. i. p. 31, 1841; Medial Tert., p. 80, pl. 45, fig. 6.
Trochita tetrica Conr., Checkl. Eoc. Fos. Smiths. Inst., p. 28, No. 817, 1866, fig'd; Journ. Acad. Nat. Sci. i. pl. 11, fig. 3; cf. p. 113, lines 8 and 9 from top of page, also ref. to plates, p. 133.
Velutina (*Otina*) *expansa* Whitfield, Am. Journ. Conch. i. p. 265, pl. 27, figs. 14, 15, 1865, (young shell, 1.0 mm. in diam.).
Leptonotis (n. g.) *expansa* Conrad, Am. Journ. Conch. ii. p. 76, 1866.

Fossil in the Eocene of the Paris Basin, and of Britain; in America in that of the Claiborne sands and in the "white limestone" above it, in the Vicksburg limestone at Vicksburg, Miss., and in the Eocene of Lee County, Tex.; in the Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, and of the Shiloh, N. J. (lowest), marl-bed; in the Chesapeake Miocene of the Choptank River, Md., and of Wilmington, N. C.

This species usually begins with the early whorls smooth or faintly striated, and, if it takes on radiating riblets or develops spines, they do not as a rule appear before the beginning of the third whorl, counting from the apex. Sometimes the whole surface is covered with vermicular shagreening, sometimes it is striated only by lines of growth, sometimes it has prominent tubular spines, and these characters, as well as elevation and depression, are united in a great variety of combinations. Conrad separated the Vicksburg form from the Claibornian, after having once united them; he separated the Miocene form from the Eocene, but the characters he gives are valueless. Any good series of specimens will show that they graduate into one another, just as the analogous variations of the recent *Crucibulum spinosum* do at the present day. To separate each mutation under a special name is to lose the lesson they teach, and multiply names to no useful purpose.

The surface of this form recalls that of the typical *Trochita*, from which it is probably not far separated, yet its intimate relation to the smooth species precludes its being set off from them. These difficulties are such as we must anticipate in following back diverging forms to their fossil progenitors.

Calyptræa centralis Conrad.

Infundibulum centralis Conr., Am. Journ. Sci. xli. p. 348, 1841; Medial Tert., p. 80, pl. 45, fig. 5, 1845.
Trochita centralis Emmons, Geol. N. C., p. 276, fig. 193, 1858.
Infundibulum concentricum H. C. Lea, Trans. Am. Phil. Soc., 2d Ser. ix. p. 249, pl. 35, fig. 39, 1845; young shell.
Trochita Collinsii Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser. viii. p. 342, pl. 44, figs. 11, 11 a, 1875.
Infundibulum Candeanum Orbigny, Moll. Cuba, ii. p. 190, pl. xxiv. figs. 28, 29, 1842.
Galerus Candeanus Dall, Hemphill's Shells, p. 335, 1883.
Galerus parvulus Dunker, Jahrb. Deut. Mal. Ges. 1875, p. 244.
Calyptræa Candeana Dall, Blake Report, p. 284, 1889.

Fossil in the Older or Chipola Miocene at one mile below Bailey's Ferry, Chipola River, Fla., Burns; in the Chesapeake Miocene at the Natural Well, Duplin County, N. C., on the Peedee River, S. C., at Petersburg, Va., Sapote, Costa Rica, and on the St. Mary's River, Md.; in the Pliocene of the Caloosahatchie beds, Florida; in the Pleistocene of South Carolina at Simmons's Bluff; and living on the coast of the United States from Cape Hatteras southward, in the Antilles and on the northern and eastern coast of South America, south to Pt. Gallegos, not far from the Straits of Magellan, U. S. Fish Commission.

This species is well marked by a sort of umbilicus on the pillar, where it is reflected, and by the arching forward of the free edge of the septum, characters which have been exactly preserved since the early Miocene. The only modification visible during the whole of that period, as represented by a full series of specimens, is a slight increase of size from the early to the later Miocene, and a slight average decrease since, the recent specimens being about the size of those from the Chipola beds, while those from the Natural Well, Duplin County, are the largest. The differences, however, are not great, and may be accidental to the particular locality rather than characteristic of chronological changes.

In addition to the species mentioned above, four species, *C. costellata* and *Diegoana* Conrad, *filosa* and *inornata* Gabb, have been described from the Miocene of California. A species which may prove to be a genuine *Trochita* has been collected from the Older Miocene marl of Jericho, N. J. The specimens have been so decorticated that it seems best to delay a description in the hope of better material. An "*Infundibulum carinatum*" has been described from the Eocene of Orangeburg, S. C. (Journ. Acad. Nat. Sci., 2d Ser. i. p. 129, pl. 14, fig. 6, 1848). It is a fragment, and described as having a carinated line at the suture—something unknown elsewhere in the group. As

Conrad does not subsequently mention it in his lists of Eocene species, I suspect it proved to be the broken tip of some other gastropod, and should be erased as a species.

Genus **CREPIDULA** Lamarck.

Crepidula Lam., Prodr., p. 78, 1799.
Crypta Humphrey, Mus. Calon., p. 4, 1797; name only.
Proscenula Perry, Conch., pl. 53 and expl. text, 1811.

Humphrey's name in an auction catalogue without figure, diagnosis, or reference to literature, is not entitled to stand against the properly proposed designation of Lamarck. The genus contains three sections, *Crepidula* s. s., with *C. fornicata* as the type, *Ianacus* Mörch, with *C. unguiformis* Lamarck as the type, and *Sandalium* Schumacher for such species as *C. aculeata* L.

Beginning in the Claibornian, we have the *C. lirata* Conrad, a well-marked striated species, of which a very exceptional spinose individual was named by Conrad *C. dumosa*. *C. cornuarietis* Lea is a synonym of *lirata*.

In the Miocene the genus exhibits luxuriance both in size and variation. It is a singular fact that many of the Miocene specimens are bored by carnivorous gastropods, while I do not remember ever having seen a recent specimen which had suffered in this way.

In discussing the characteristics of the forms of *Crepidula* with the idea of differentiating groups which may have the rank of species, it is necessary to take into account the influence of the environment, which, as *Crepidula* is a sedentary animal, is particularly strong in this case. It has already been observed that the station in perching mollusks is very influential in affecting their characteristics. On a careful inspection of large multitudes of specimens it will be seen, as a rule, that those which have the plane of their pedestal markedly convex and narrow are not only necessarily compressed and dorsally high-arched, but that they tend to have the apex elevated from the basal margin and the cavity of the beak ventral to the septum prolonged over the posterior margin. In the Gulf of Mexico a form of *Crepidula* perches on *Cerithium muscarum*. It cannot grow larger, basally, than its perch; owing to the irregularity of the shell-surface, to which its base exactly conforms, it would almost certainly perish if it tried to seek another *situs*. It fulfills its growth by becoming especially high and arched in the back, and the beak both above and below the septum is very deep, though the aperture is small. It is obvious that its opportunities for growth are narrowly limited. Its food must also be limited to that common to the limited haunts of the *Cerithium*. As we know in some cases the color of the food directly affects the individual, dynamically and with no delays for natural selection, so in this case such effect on its characters as may be due to food would also be limited. The *Cerithium* is a rather active animal, and to retain its foothold the *Crepidula* must have a good development of its pedal muscle. Since this muscle is so attached that the septum to some extent serves as a fulcrum, it is obvious that a direct effect is also liable to be exerted on the fulcrum or septum which may tend to modify it as compared with the septum of an individual seated on a broad or flat pedestal. These characters, once assumed, might be more or less fortified by natural selection, but it is also obvious that they may be induced and maintained directly by environmental influences, and in my opinion many characters, especially in littoral mollusks, are directly so maintained and originated; the influence of selection being of comparatively small importance, so far as they are concerned.

That this is the case in the genus *Crepidula*, I have little doubt. The opinion is fortified by the fact that in all countries where Crepidulæ flourish, and the circumstances admit it, we have certain forms of shell developed in connection with a certain *situs*. Beside a large species, in our case *C. fornicata*, suited for oyster-beds, large bivalves, flat stones and similar situations, we have a flat form, *C. plana* (or *unguiformis*), found in dark, concave places, especially the interior of dead gastropod shells. I have received *C. plana* from Texas, bearing in fine yellow-brown lines the distinctive pattern of *fornicata's* ramose color-markings. When a *C. plana* gets out of place and develops on a convex base such as the outside of a gastropod shell, the beak will almost always show a reminiscent touch of brown color, indicating that the pressure of the environment which produced in the parent whiteness and depression being removed, the hereditary characters of the ancestry begin, especially in the young, to reassert themselves. I suspect that if *C. plana* were reared for several generations in an aquarium, where it was obliged to live on a wide convex surface, it would rapidly lose its acquired (and supposedly characteristic) whiteness and peculiar form. I am aware that it has been claimed that the dentition and other features in the section *Ianacus* are different from those of the true *Crepidula*, but (apart from the modification in these due to environment) the amount and importance of these differences have never been subjected to a sufficiently thorough test to indicate their value.

Again, in nearly all coasts we have a form of *Crepidula* which is found seated on a convex and limited area, such as the shell of another mollusk or the surface of small pebbles. On our own coast this form is represented by *C. convexa*, on the California coast by *C. adunca*, etc. The differences these shells exhibit by reason of heredity, selection and environmental pressure may have become sufficiently fixed to be regarded as of specific value. The point to which I desire to call attention is that, primarily, the differences are not due to variation and selection, but to the immediate and effective impact of the environmental forces. As we go back in the geological column and examine large numbers of specimens, we find that intermediate individuals and graduated differences are far more common than in the recent representatives of the same type. This is what theory would lead us to expect, and it is satisfactory to recognize in this way the truth of our notions as to the action of natural forces. Here, again, a word of warning to the student may be justified. If all these differences be marked with names, and the specimens put in separate trays and studied, as one may say, a batch at a time, instead of all together, it will be much more difficult to grasp general ideas in regard to them, or to make way against the traditions which regard, unconsciously, a species as formerly defined, something with exact and sharp boundaries, and which is capable of precise estimation apart from any other. And for this reason I feel strongly that the undue multiplication of mere names is a serious stumbling-block in the way of progress in all the essentials of the science. A name is a handle; and a thing needs one or at most two handles to be properly managed. If it bristle with handles like a porcupine with quills, we are necessarily driven to let it alone, and they serve no good purpose.

Crepidula fornicata (Lam.) Say.

Crepidula fornicata (Lam.) Say, Journ. Acad, Nat. Sci. Phila. ii. p. 225, 1822; Conrad, Medial Tert., pl. 45, fig. 10.
C. glauca Say, *op. cit.* p. 226, 1822.
C. cymbæformis Conr., Proc. Acad. Nat. Sci. ii. p. 173, 1844; Medial Tert., p. 81, pl. 45, fig. 7.
C. densata Conr., Proc. Acad. Nat. Sci. Phila. i. p. 311, 1843; Medial Tert., p. 81, pl. 45, fig. 9.
C. ponderosa H. C. Lea, Trans. Am. Phil. Soc., 2d Ser. ix. p. 249, pl. 35, fig. 40, 1845
C. cornucopia H. C. Lea, *op. cit.* p. 250, pl. 35, fig. 41, 1845.
C. rostrata Conr., Am. Journ. Conch. vi. p. 77, 1871.
C. virginica Conr., *id.* p. 78, 1871.
C. recurvirostra Conr., *id.* p. 78, 1871.

Older Miocene of Santo Domingo, Gabb, and of the Chipola beds, Chipola River, Florida, Burns; Chesapeake Miocene throughout; Pliocene of Dismal Swamp, Va., of North and South Carolina, of Costa Rica, of the Caloosahatchie beds and Shell Creek, Florida; Post-Pliocene of South Carolina and of North Creek, Little Sarasota Bay, Florida; living on the eastern shores of America from Prince Edward's Island to the northern shores of South America, including the West Indian Islands.

The typical *fornicata* is found as characteristic in the Chesapeake Miocene as in the recent fauna. *C. cymbæformis* is a station variety due to growth on a narrow, arched surface of moderately large size, such as the exterior of a *Melongena* shell.

C. ponderosa is due to luxuriant growth on a similar but smaller surface, necessitating an increased vertical and consequently spiral enlargement; *C. densata* to growth on a flatter but still inconveniently limited surface in the matter of area; *C. rostrata* is one of a series of Crepidulæ which probably grew on each other's backs, as they may frequently be seen to do now among the oyster-beds, sometimes as many as six being mounted one upon another; *C. recurvirostra* is the same thing, and *C. virginica* is a frank synonym of the typical *fornicata*.

From the variety *cymbæformis* the recent *C. convexa* Say is derived, but earlier than the Pliocene; the intergrading is too close to permit us to separate the specimens specifically.

Crepidula convexa Say.

C. convexa Say, Journ. Acad. Nat. Sci. Phila. ii. p. 227, 1822.

Newer Pliocene of the Myakka River, Fla., Willcox; Post-Pliocene of Sankoty Head, Mass., Verrill, and of North Creek, Fla., Dall and Willcox; and of Simmons's Bluff, South Carolina, Burns; living on the coasts of the United States from Nova Scotia to East Florida, and west on the north shore of the Gulf to Galveston.

There is a flat form of *convexa* growing on flat stones or oysters which much resembles that mutation of *C. fornicata* which Say called *glauca*, and the name of *glauca* has been applied to it, notwithstanding that Say's description in speaking of the indented edge of the septum of *glauca* (which in *convexa* is straight) shows that the shell he had in mind was not *convexa*, at any rate. Even if the two names were founded on mutations of a single species, since they were printed simultaneously, it would be better to retain of the two the much more characteristic name of *convexa*.

Crepidula aculeata Gmelin, var. **costata** Morton.

Patella aculeata Gmelin, Syst. Nat., p. 3693, 1788.

C. costata Morton, Journ. Acad. Nat. Sci. Phila. vi. p. 115, pl. 7, figs. 2, 3, 1829; Tuomey and Holmes, Pleioc. Fos. S. Car., pl. 25, fig. 11, 1857.

C. spinosa Conrad, Proc. Acad. Nat. Sci. Phila. i. p. 377, 1843; Medial Tert., p. 81, pl. 45, fig. 8, Tuomey and Holmes, Pleioc. Fos. S. C., pl. 25, fig. 10, 1857.

Crepidula aculeata Dall, Bull. U. S. Nat. Mus. No. 37, p. 152, 1889.

Fossil in the Newer Miocene of the Chesapeake formation in Maryland, Virginia, North and South Carolina and in the upper bed at Alum Bluff, Florida, The typical form, *aculeata*, appears in the Floridian Pliocene at De Leon Springs on the Caloosahatchie, Shell Creek and Alligator Creek, Dall and Willcox; living from latitude 35° N. to latitude 35° S. on the eastern shores of both Americas and eastward to Mauritius; from low-water mark to 589 fathoms (Blake Exp.).

The distinction between the Miocene *C. costata* and the recent *spinosa* is merely one of size and depth. The same variations in sculpture occur in both; the evenly striated, flattish Miocene specimens are the typical *costata*; *spinosa* was founded on a specimen in which the radiating riblets were somewhat alternated, with the larger ones spinose; in other specimens all are spinose. The alternated, partly spinose type is the most common both in the fossil and recent shells. None of the smaller specimens of the Miocene shells and none at all of the Pliocene specimens can be separated by valid characters from the recent *C. aculeata*. The type is represented on the Pacific coast by the somewhat degenerate but very similar *C. lingulata* Brod., which is found there from the Pliocene to the recent fauna.

Crepidula plana Say.

C. plana Say, Journ. Acad. Nat. Sci. Phila. ii. p. 226, 1822; Tuomey and Holmes, Pleioc. Fos. S. C., p. 111, pl. 25, fig. 12, 1857; Emmons, Geol. N. C., p. 276, fig. 195, 1858.
C. unguiformis Lamarck, of many authorities.
C. protea Orbigny, Moll. Cuba, ii. p. 192, pl. xxiv. figs. 30–33, 1842; Dall, Blake Gastr., p. 285, 1889.
C. lamina H. C. Lea, Trans. Am. Phil. Soc., 2d Ser. ix. p. 250, pl. 35, fig. 42, 1845.

Fossil in the Older Miocene of the Chipola beds, Burns, and of the Antilles, Gabb, Guppy, etc.; in the Chesapeake Miocene throughout; in the Pliocene of the Caloosahatchie and Myakka River, Fla., Willcox; in the Post-Pliocene of North Creek, Fla., Simmons's Bluff, S. C., and Sankoty Head, Mass.; and living along the whole coast, from Prince Edward's Island southward in the cavity of dead shells and rarely on their exterior.

Having much confidence that this form will prove to be a dynamic mutation of other resident species, both in the fossil and the recent faunas, I prefer to adopt a name for it which applies strictly to the American form, though the latter cannot be distinguished by the shell from the European *unguiformis* and analogous individuals found in foreign waters in most parts of the world. The fossils are absolutely identical in all essential characters with the recent specimens.

Beside the species above mentioned, there are two forms from the California and Oregon Miocene which should probably be united, the *C. princeps* and *C. prærupta* Conrad, the latter name having priority. Both have been united with *C. grandis* Middendorf, but after studying a large number of this recent species I cannot agree with this view of the matter. The *C. prærupta* is much more like *C. ponderosa* Lea than the recent shell. It occurs also very abundantly in the Miocene of Alaska at the northern shore of Unga and Popoff Islands, Shumagins, and in the Pliocene of California. *C. rostralis* Conr., from the Astoria Miocene, is probably identical with *C. adunca* Sby., which is found in the Pliocene and recent faunas of California. *C. dorsata* Brod. is also reported from the California Pliocene. Gabb has proposed for a small, obliquely twisted *Crepidula* of the California Eocene the subgeneric name of *Spirocrypta*, but with our present knowledge this subdivision seems hardly needed; his type is *C. pileum* Gabb, from the Tejon group.

FAMILY CAPULIDÆ.

The species of this family are curiously absent from the shallow waters of the coast and from the Tertiary beds. *Capulus americanus* Conrad belongs in the next family, and should be referred to the genus *Amalthea*. The peculiar irregularities of its aperture show that it was a commensal or semiparasitic species, probably on some echinoid. It is from the Eocene of Jackson, Miss. The *Capulus Bullii* of Meek's Checklist of Miocene Fossils is the cup of a *Crucibulum*, described as an *Hipponyx* by Tuomey and Holmes, and referred to the "genus" *Cochlolepas* Klein by Conrad. *Capulus lugubris* Conrad is a brachiopod belonging to the genus *Discinisca*, and found from the earlier Miocene upward to the Pliocene beds. It is probable that the *Capulus complectus* Aldrich, when more fully investigated, may turn out to be an *Amalthea* also. It is from the Wood's Bluff and Lisbon, Ala., Eocene.

FAMILY AMALTHEIDÆ.

Genus AMALTHEA Schumacher.

Amalthea pygmæa Lea.

Hipponyx pygmæa Lea, Contr. Geol., p. 95, pl. 3, fig. 75, 1833.
Cochlolepas pygmæa Conr., Am. Journ. Conch. i. p. 33, 1865.
Rotella (*Helcion*) *pygmæa* De Gregorio, Mon. Eoc. Ala., p. 147, pl. 14, figs. 4-7, 1890.
Hipponix ingrediens De Greg., *op. cit.* p. 146, pl. 14, figs. 8, 9.

Fossil in the Claibornian and in the Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, Burns and Dall.

It is probable that M. de Gregorio's "*Rotella*" is a printer's error for *Patella*. He figures an extremely minute specimen (1 mm.) of Lea's species as a "*Rotella*," and a larger one with the apex worn off as a new and "dubious" species of *Hipponyx*. At least the figures and description lend themselves to this supposition. It is curious that the muscular impression of the shell, which he reproduces from Lea, did not put him on his guard, since it shows that it is impossible for the shell to belong to the *Patellidæ*.

A single specimen of this species was collected at Ballast Point, adding another to the already respectable list of species which survived from Upper Eocene into the Chipola Miocene.

Amalthea Willcoxii n. s.

Plate 17, figure 6.

Shell small, conical (the nucleus lost), slightly dextrally twisted, sculptured with numerous regular concentric ridges over which radiating riblets proceed from near the apex to the base, becoming somewhat tubercular at the intersections; apex in the posterior fourth, elevated; base oval; margin slightly crenulated by the sculpture or simple; muscular impressions as usual in the genus. Alt. of shell 5.5; transverse diam. of base 6.0; long. of base 9.0 mm.

This very pretty little species is quite distinct from any of the other species recent or fossil of the region. It is perhaps nearest to *A. subrufa* (Lam.) Cpr., of the Antilles. I refer it to *Amalthea* rather than *Capulus*, on account of the irregularities of the basal margin and the bluntness of the apex, which agree better with the former genus than with the latter.

Amalthea antiquata Linné.

A. antiquata Dall, Bull. U. S. Nat. Mus. No. 37, p. 154, No. 883, 1889.

Fossil in the Pliocene of the Caloosahatchie beds, Dall; living from the

Florida coast south to the Antilles, Brazil, Ascension Island, and in the Pacific from California to Peru.

A single specimen in perfect condition was found in the marls.

An imperfect cast of an *Amalthea*, resembling *A. Willcoxii*, but with less prominent radiating sculpture, was found by the writer in the "white limestone," or Jacksonian, from the bluff at Claiborne, Alabama. A curious fossil has been described from the Costa Rica Pliocene, under the name of *Hipponyx crepidula*, by Gabb. It is certainly not a mollusk, and has somewhat the aspect of one of the shelly appendages of a cirrhipede like *Scalpellum*. Several species of *Amalthea*, common to the recent fauna, are found in the Pliocene and later beds of the Californian coast.

FAMILY XENOPHORIDÆ.

Genus **XENOPHORA** Fischer.

Xenophora conchyliophora Born.

Plate 4, figures 10, 10 a.

Trochus conchyliophorus Born, Mus. Cæs. Ind., p. 333, 1778.
Xenophora lævigata G. Fischer, Tabl. Syn. Zoogn., p. 113, 1808.
? *Trochus leprosus* Morton, Syn. Org. Rem., p. 46, pl. 15, fig. 6, 1834.
Phorus reclusus Conr., Proc. Acad. Nat. Sci. vii. p. 262, 1855; Wailes, Geol. Rep. Miss., p. 289, pl. 17, figs. 6 a, 6 b, 1854.
Onustus reclusus Conr., Am. Journ. Conch. i. p. 33, 1865.
Xenophora humilis Dall, Part i. p. 182, pl. 4, figs. 10, 10 a; not of Conrad.
Xenophora agglutinans (Lam.) De Gregorio, Mon. Eoc. Ala., p. 144, 1890.
Xenophora reclusa De Gregorio, *op. cit.* p. 144.

Uppermost Cretaceous (Ripley) of Alabama, at Prairie Bluff, Ala., Morton and Conrad, and of Crosswicks, N. J., Whitfield; Eocene of Wood's Bluff, Ala., Aldrich; of Jackson, Miss., Wailes and Conrad; Older Miocene of the Chipola group, in the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Willcox; and of the Tampa limestone at Bartow, Fla., Eldridge; Newer Miocene of Cape Fear River at Mrs. Purdy's marl-bed, Johnson; Pliocene of the Caloosahatchie and Shell Creek, Fla., Dall and Willcox; living in moderate depths of water off the eastern coast of the United States from Cape Hatteras southward to the Antilles and in the Gulf of Mexico, U. S. Fish Commission.

Since this group remounts in the geological scale to the Devonian, it is not so extraordinary that one of the species should persist from the uppermost Cretaceous to the present day. No differential characters have ever been recorded which would separate Morton's shell from the Eocene form which follows it, and I can assert with confidence that the latter cannot be discriminated from the Miocene and recent forms by any constant characters. If this succession be admitted, it is a strong testimony to the protective value of the device by which the members of this family defend themselves.

The specimen figured in Part I. was hastily identified as *X. humilis* from a specimen so named in the collection, but on examination later I found the names had been misapplied to the two species in the old Smithsonian collection, as was proved by the original diagnoses. In the recent fauna two types of this family are represented, the present species and *X.* (*Tugurium*) *caribbæa* Petit. The typical form is more elevated, has only a slight chink or even no umbilical perforation (individuals vary in this respect at different ages), and the periphery is not produced into a lamina. In *Tugurium* the periphery is thin and produced far beyond the normal whorl, and there is a funicular umbilicus. There are also anatomical differences. In the Eocene we have the present species and also *X. humilis* Conrad, which is depressed and has a moderate umbilicus, but the periphery not lamellar, and the upper surface well covered with attached bodies. It is found in the "white limestone" of Claiborne Bluff (Jacksonian), at Jackson and Vicksburg, Miss., and in the limestone of Richards' quarry at Ocala, Florida, belonging to the final or nummulitic phase of the Vicksburg.

It is followed in the Older Miocene of the Chipola beds by an analogous form, *X. textilina* Dall, which differs in having the granulation of the surface coarser and stronger, being marked even on the upper surface, and in having the base, especially round the umbilicus (which is small and sometimes nearly closed), distinctly spirally grooved. This shell reaches 55 mm. in diameter (exclusive of its load, which is a large one), has eight or nine whorls, and an elevation of 35 mm. The basal grooves are shallow and narrower than their interspaces, which have the effect of half a dozen flattish spiral ribs. The umbilicus is larger than in *X. conchyliophora*, but not so large as in *Tugurium*. The basal margin is little excavated, and not at all produced.

Xenophora extensa Sby. was identified from the Shark River, N. J., Eocene by Conrad, but the species found there is not likely to be the British shell, but is more probably *X. humilis.*

Xenophora lapiferens Whitfield is an interesting new species from the New Jersey Eocene marls. Its load is composed of single pebbles, which are attached on the middle of the whorl instead of near the edge (a peculiarity I have not noticed in any other species), and not very close together; thus the regularity of the suture is little interfered with, and with the exception of the pits of attachment the spire forms a nearly smooth cone more than twice as wide as it is high. The umbilicus is closed and the base slightly convex or flattish, not excavated near the periphery.

From the Eoçene of Carson's Creek, Wayne County, Miss., five miles south of Shubuta, we have an interesting species of the other subgenus, *X.* (*Tugurium*) *conica* Dall. This has the periphery extended in scalloped points each of which bears a very small extraneous piece of shell, or none; the spire is flatly conical, with a subacute apex and eight whorls, the suture closely appressed; the surface is marked by lines of growth and a few obsolete spiral striæ near the periphery; the base is similarly sculptured, almost smooth, excavated near the periphery, with a funicular umbilicus in which the lines of growth are much elevated. Alt. 11; max. diam. 18 mm. The stellate margin, nearly smooth surface and conical form will distinguish it easily from any other American Tertiary species.

Onustus annosus of Conrad (Am. Journ. Conch. v. p. 42, pl. i. fig. 4), from the Shark River Eocene of New Jersey, is a *Solarium* of the group of *S. elaboratum*, and does not belong to this family at all. It is probably the same as one of the southern species, but the specimens found, so far, are too poor to determine this with certainty.

FAMILY NATICIDÆ.

Genus NATICA (Adanson) Scopoli.

Natica (Adans.) Scopoli, Introd. Hist. Nat., p. 392, 1777; Bruguière, Enc. Meth. i. p. xvi., 1789; Lamarck, Prodrome, p. 77, 1799.
Cochlis Bolten, 1798, + *Nacca* Risso, 1826.

In introducing Adanson's name into binomial nomenclature Scopoli cited four examples, of which two are genuine Naticas as of late restricted, *N. rufa* Born and *N. vitellus* Linné, one was a *Neverita* (*albumen L.*), and the fourth an *Ampullaria*-like shell, *Nerita lusitanica* Linné, variously identified by different authors.

Lamarck's type was *N. canrena*, so it may be considered positively settled that the typical *Natica* has an umbilicus furnished with internal ribs and a sulcate shelly operculum. The extent of the genus is so great that it seems advisable to divide it; though, as pointed out clearly by Zittel, the forms so distinct in the existing seas are more or less closely united by their fossil representatives. For present purposes we may refer to *Natica* Scopoli (*non* Risso + *Nacca* Risso) all the species having a calcareous operculum, while for those having a horny operculum (the oldest name, *Uber* Humphrey, not having been defined) we must probably adopt *Polynices* Montfort, 1810. *Ampullina*, which seems to have been suggested in the vernacular by Faujas St. Fond as early as 1803, and was hesitatingly dealt with by Lamarck, Defrance and others without being formally defined or adopted, was finally introduced into systematic nomenclature by Bowdich in 1822 (Elem. Conch. i. p. 31). Each of these groups is susceptible of further division into sub-genera, on characters drawn from the features of the shell. Under *Natica* proper, among others, we have *Cochlis* (Bolt.) Mörch for the species with a single marginal rib to the operculum, *Natica* s. s. for those with a multisulcate operculum, *Stigmaulax* Mörch for those with a sulcate or reticulate shell, and *Cryptonatica* Dall for those forms with a smooth calcareous operculum and an umbilicus entirely and smoothly filled with callus, such as *N. clausa* B. and S., *N. russa* Gould, *N. pusilla* Say, etc.; all the previously enumerated groups having the umbilicus open and more or less complicated by spiral grooves or ribs which terminate bluntly at the margin of the aperture.

In discussing this genus in its widest sense, it should be borne in mind that there is a certain difference of form between the sexes. The males, as usual, are apt to be smaller and, not having to carry the enormous egg-sack of the females, have the " shoulder " of the shell, or that part of the whorl just in front of the suture, less inflated, giving the whole shell a more evenly conical and less scalar spire. These differences are more marked in the group having a corneous operculum, but are perceptible in the others, especially those with an elevated spire.

Apart from sexual differences, there is a certain variability about the coil of the shell, some specimens having a decidedly wider umbilicus than others of the same species, and the grooves and spiral ribs of the interior of the umbilicus vary within certain limits between individuals and also have a certain range of fluctuation in the same individual at different times, since the growth of the margin of the outer lip, and of the inner lip, including the end of the umbilical rib or ribs, do not always preserve an undeviating ratio to one another, a deposit apparently taking place on the one or the other at different times and not always coincidently.

In treating of the fossils, too, it should be remarked that the outer layers of the shell seem to be less intimately soldered to the inner ones than in many other groups, and therefore it is not uncommon for a fossil specimen by decortication to lose its normal aspect entirely, without appearing to lose its symmetry, the result being often very deceptive. This is especially the case with *Lunatia*, *Neverita*, etc., and is not so marked in the forms belonging to *Natica* proper. As between youth and old age, a very marked difference may sometimes be observed in the umbilical characters of specimens of the same species.

In the group of *Ampullina* young specimens sometimes show strong, rounded ribs, or a narrow but distinct sulcus, bounding the umbilical fasciole. In the adult these characters may become so obsolete that only by means of a series of different ages is one able to determine that they belong to the same group. One such form when quite young seems almost like the type of a new section, and when full-grown can hardly be distinguished from an ordinary *Lunatia* by the shell characters. The same species may be found to have the umbilicus bounded by a sharp elevated thread, or by an equally sharp groove, and the gradual modification of a groove into a thread—if such an expression may be used—is one of the most interesting and instructive object-lessons on the mutability of specific limits. It may be admitted that most of these mutations are of Eocene age, and that, in the lapse of time since that formative period, the specific characters of the forms which have survived have become more definitely marked. But even now the forms with a corneous operculum exhibit a wide range of variation. That those species with a shelly operculum are less variable, I regard as the direct result of the dynamic influence of the rigid operculum itself on the soft parts of the animal which bears it—a view upon which I cannot expatiate here, but which opens up an interesting and almost virgin field for inquiry.

Subgenus **Natica** s. s.

Natica canrena (Linné) Mörch.

Nerita canrena (Linné *pars*) Auct., Mörch, Malak. Blatt. 24, p. 62, 1877.
Natica canrena Tuomey and Holmes, Pleioc. Fos. S. C., p. 115, pl. 25, fig. 17, 1857; Emmons, Geol. N. C., p. 267, fig. 152, 1858.
Natica plicatella Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 564, 1863; Am. Journ. Conch. iii. p. 259, pl. 24, f. 3, 1867.

Older Miocene of Santo Domingo, of Bowden, Jamaica, and the Chipola beds, N. W. Florida; Newer Miocene of North Carolina, at Wilmington; Pliocene of Costa Rica, Gabb, and of the Caloosahatchie, Shell Creek, Alligator Creek, etc., Florida, Dall and Willcox; living from Cape Hatteras southward on the coasts of the United States and the Antilles and of South America to Pernambuco.

Hanley has shown that the *canrena* of Linné was a compound of several different species, and that which later authors have generally accepted as the true *canrena* is that figured by Lister. Deshayes would reject the name *canrena* altogether on account of this confusion, but it is doubtful if this would be allowable. The East Indian species, *N. ala-papilionis*, is the one most commonly confounded with the American form, and it is figured under the name of *canrena* in the excellent manual of Dr. Fischer (Pl. viii. f. 1). If the name *canrena* should be retained for the Asiatic species, which has a different operculum from the American shell, the earliest name for the latter seems to be *pellis-erminea* of Martyn.

Conrad proposed for the Miocene fossil the name of *N. plicatella*, which may be used in a varietal sense to cover the older Miocene forms, in which, though the shells are absolutely identical, the operculum differs slightly from that of the newer Miocene, Pliocene and recent shells. The latter has about ten channelled, deep grooves, separating as many flattened, subequal ribs, which become narrower and more keeled toward the outer margin of the operculum. The central portion of the latter has an irregular, little-elevated, callous area. In the operculum of the variety *plicatella*, as here restricted, the central callus is more elevated, with its margin limited by a conspicuous groove, while another similar groove separates the outermost rib from those inside from it. This character may not be constant, but until this is shown it would seem advisable to retain the varietal name, notwithstanding the shells offer no differential characters. We have a somewhat similar case in the recent *Fasciolaria princeps* of California and *F. gigantea* Kiener of Florida. The shells cannot be differentiated, but the opercula are markedly unlike.

The Eocene precursor of this type seems to be *Natica semilunata* Lea, of which *N. minor* Lea is merely a young and elevated specimen. In this species the young has the umbilical rib very distinct, but in completely adult specimens the rib has frequently become so obsolete as to have practically vanished. The very large series in the National Collection shows this distinctly. Conrad, in Morton's Synopsis, confounds *N. gibbosa* Lea, which is a *Neverita*, with *N. semilunata*, and refers them both to his (or Say and Morton's) *N. ætites*, and subsequently restores both to specific rank (Am. Journ. Conch. i. p. 27, 1865); but the species named in Say and Morton's leaflet were not recognizably described, and in sixty years have not been figured, so that we may properly ignore them, so far as they conflict with Lea's figures and diagnoses. *N. semilunata* is known from the Claiborne sands and Lee County, Texas. The operculum seems to be unknown.

It has been referred, as I think incorrectly, to *N. epiglottina* Lam. by De Gregorio, who figures quite a different species under the name of *semilunata*. He regards the problematical *N. ætites* Conrad as a synonym, following Bronn. He also figures a variety of *semilunata* under the name of *N. Matheroni* Desh.

Another species of the Eocene belonging in this vicinity is *N. permunda* Conrad (Proc. Acad. Nat. Sci. 1855, p. 260; Wailes, Geol. Miss., pl. 16, fig. 2), which is readily separated from *N. canrena* by the absence of the radiating sulci on the spire. It is found in the Prairie Creek beds, Wilcox County, Alabama, and in the upper Eocene of Ucutta Creek, Garland's Creek, and Jackson, Miss. An apparently direct descendant of *N. permunda* is found in the following species:

Natica alticallosa n. s.

Plate 22, figure 28.

Older Miocene of the Chipola beds at Ten-Mile Creek and on the Chipola River, one mile from Bailey's Ferry, and in the lower bed at Alum Bluff, Calhoun County, Florida.

Shell resembling *N. permunda* Conrad, but smaller, and best described by a differential diagnosis.

Shell of four well-rounded whorls, with the suture well marked and the surface smooth, except for lines of growth which are sometimes slightly elevated near the suture; male with the suture less impressed and the spire more evenly sloping than in the other sex; spire slightly less elevated than in *N. permunda;* aperture with a thick body-callus continuous with the umbilical callus; the latter in *N. permunda* is coiled on the middle of the umbilical wall, with a space between it and the antecedent whorl; in *N. alticallosa* the callus fills the upper two-thirds of the umbilicus completely, and sometimes nearly reaches the umbilical carina, which last is less sharply defined than in *N. permunda*, and consequently the aperture at the base of the pillar is somewhat less angular and effuse than in that species. Alt. of shell 18; max. diam. 18 mm.

The subsutural callus in this species is generally separated from the outer lip at the body by an obscure groove, and the callus here projects forward on the body beyond the lip. The operculum is unknown.

Another Eocene species which should probably be referred to this subgenus is *N. magno-umbilicata* Lea, a small species with a deep suture, usually marked above with sharp radiating wrinkles, and having a rather wide carinated and excavated umbilicus marked with numerous sharp, elevated, fine spiral threads, which, in the young, serrate the umbilical edge of the pillar, but in the fully grown become much more feeble. It is known from the Claiborne sands and Wood's Bluff, Ala. It is the *N. bisulcata* of Heilprin, and has been referred by De Gregorio to *N. Noæ* Orbigny as a variety, though *N. Noæ* was described in 1850 and *N. magno-umbilicata* in 1833. I am unable to decide, for want of sufficient foreign material, whether the European fossil is really identical with that from Claiborne or not.

Subgenus **Stigmaulax** Mörch.

This group is not known to be represented in our older Miocene, but appears in that of Bowden, Jamaica, and of Haiti, where the *N.* (*S.*) *sulcata* Born is rather common, not differing in any respect from recent specimens. It is figured by Guppy (Quart. Journ. Geol. Soc. xxii. p. 290, pl. xviii. figs. 14, 15, 1866).

Subgenus **Cryptonatica** Dall.

Natica (Cryptonatica) floridana n. s.

Plate 17, figure 5.

Older Miocene of the Chipola beds, Calhoun Co., Florida, and of the Orthaulax bed, Tampa Bay, Florida, Willcox, Dall and Burns.

Shell small, compact, the males with more sloping, the females with four or five more rounded, whorls; suture distinct, not channelled; the whorl near it marked by lines of growth often forming slightly elevated wrinkles; the remainder of the surface smooth, more or less polished; base rounded or in the males slightly flattened, with a tendency to an obtuse carina at the periphery and also on the margin of the umbilicus; umbilicus rather wide, almost filled with a semilunar callus, smooth and flattish on its outer surface, rounding into a shallow chink on the left side of the umbilicus or, especially in the young, sometimes practically filling it; callus on the body well developed, with a short, shallow subsutural groove in the adult; aperture with the outer lip thin-edged, half-moon-shaped, rounding evenly into the pillar. Alt. of adult shell 16.5; diam. 17.0 mm..

This species probably belongs to *Cryptonatica*, although the operculum has not turned up. The specimen figured from Ballast Point, though perfect, is quite young; fully adult specimens from Chipola were only obtained later. It is remarkable for the difference (probably sexual) between the rounded and the flattened specimens, all gradations between the two being shown by the series before me.

Natica (Cryptonatica) pusilla Say.

Natica pusilla Say, Journ. Acad. Nat. Sci. Phila. ii. p. 257, 1822; Dall, Bull. 37 U. S. Nat. Mus., p. 154, pl. 50, fig. 21, 1889.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox; Post-Pliocene of Simmons's Bluff, S. C., Burns; living on the coast of the United States from Massachusetts to the Florida Keys and westward to Texas, in 2 to 15 fathoms.

This pretty little species may perhaps be regarded as a recent analogue of *N. floridana*, which it much resembles, but on a much smaller scale.

Genus **POLYNICES** Montfort.

Polynices Montf., Conch. ii. p. 223, 1810; type *N. mammilla* Lin.

This group in its widest sense is here taken as including all the *Naticidæ* with corneous opercula. It is divisible into several subgenera based on the form of the shell.

Polynices s. s. will include the simply colored mammiform species with a smooth surface and the umbilicus usually solidly filled with callus.

Naticina Guilding (*non* Fischer) is a synonym, though the name has been wrongly applied to the Naticiform *Sigareti* called *Eunaticina* by Fischer and *Sigatica* by Meyer.

Neverita includes the large, rather depressed forms usually grouped under this name.

Lunatia Gray includes the thin, globose species with a small umbilicus indistinctly or not at all ribbed internally, and a small callus on the pillar or none.

Mammilla Schumacher includes the forms resembling *Polynices* s. s. in form, but with thinner shells, a partially open umbilicus, and, in life, a conspicuous epidermis.

Payraudeautia B. D. & D. has the umbilicus of *Natica* s. s., doubly ribbed and excavated, but a horny operculum.

Ampullina (Lam.) Bowdich, 1822, covers the singular Eocene forms in which the umbilical carina is sharp, and in the section *Ampullinopsis* Conrad, 1865 (*Megatylotus* Fischer), has an elevated spire with a channelled suture; in *Cernina* Gray has the spire depressed, the suture simple, and the umbilical region hidden in a profuse callus; both these have a smooth surface, while *Lacunaria* Conrad has an elevated, sharp spire, a narrow umbilicus, not callosified, and a thin, sometimes sculptured shell. Type *N. alabamiensis* Whitfield.

Amauropsis Mörch has a thin, nearly or quite imperforate shell with a channelled suture; it is probably not nearly related to *Amaura* Möller.

There are a number of other groups not represented in our Tertiary, and which it is not necessary to refer to at present.

Subgenus **Neverita** Risso.

This group is represented in the Eocene by *N. gibbosa* Lea, with which the insufficiently described and unfigured *N. limula* Conrad may be identical. This species has a rather prominent nucleus and a somewhat gibbous form. The type is a rather elevated shell. The very young are marked on the umbilical callus with several transverse grooves, where most of the species of *Neverita* have a single groove; the character is peculiar, but somewhat variable. These young shells have received the name of *arata* from Gabb. Lea also describes, under the name of *N. mamma*, a small depressed form, which may be a variety of *gibbosa*, but which is without doubt the precursor of *N. duplicata* in the Eocene, and is exactly reproduced in the Old Miocene of Shiloh, N. J. Some of the young specimens from the Miocene retain the multiple grooving of the callus in *N. gibbosa*, but most of them from the Chipola beds exhibit rounded whorls, an excavated, spirally striated umbilicus only half filled by the callus, which has its surface divided by a deep transverse sulcus. It is difficult to decide whether this form should be assigned, as a variety *chipolana*, to the Eocene *gibbosa* or to the Miocene *duplicata*, or whether it should be regarded as a distinct species from either. In any case it is an almost exactly intermediate form between them. It reaches an altitude and diameter of 29 mm. and has been obtained from the lower bed at Alum Bluff and the Old Miocene of the Chipola River. Another Eocene form which may belong in this vicinity is the *N. aperta* Whitfield (not of Lovén or Lea), which at first sight would seem referable to the subgenus *Mammilla*, the umbilicus being large and flaring, and in the young state at least entirely without a callus. The form named *N. onusta* by Whitfield, otherwise identical with his *N. aperta*, has the umbilicus plumply filled by a rounded callus. One specimen in the National Collection, among those which had been referred to *N. aperta* Whitfield, has an incipient callus forming, and I am led to suspect that this species delays forming a callus until the shell is fully grown and then adds it, and that therefore *N. aperta* and *N. onusta* should be consolidated under the last-mentioned specific name. The species is found in the Eocene of Wood's Bluff and Gregg's Landing, Alabama.

Polynices (Neverita) duplicatus Say.

Natica duplicata Say, Journ. Acad. Nat. Sci. Phila. ii. p. 247, 1822

Neverita duplicata (Say) Dall, Bull. 37 U. S. Nat. Mus., p. 154, pl. 51, figure 12, 1889.

Natica campeachiensis (Recluz MS.) Reeve, Conch. Icon. *Natica*, pl. 1, fig. 1, 1855; Tryon, Man. viii. p. 34, pl. 13, fig. 10, 1886.

Natica texasiana Phil., Zeitschr. f. Mal. for 1848, p. 158; Tryon, *op. cit.* p. 34, pl. 12, fig. 5, 1886.

Natica fossata Gould, Proc. Bost. Soc. Nat. Hist. ii. p. 263, 1847; Tryon, *op. cit.* p. 34, pl. 12, fig. 4, 1886.

Neverita Emmonsii Conr., Am. Journ. Conch. iii. p. 259, pl. 24, fig. 2, 1867; Emmons, Geol. Rep. N. C., p. 267, fig. 151, 1858.

Neverita densata Conr., Am. Journ. Conch. iii. p. 259, pl. 24, fig. 5, 1867; Emmons, *op. cit.* p. 266, fig. 150, 1858.

Natica percallosa Conrad, Am. Journ. Sci. xli. p. 348, 1841; Am. Journ. Conch. iv. p. 66, pl. vi. fig. 6, 1868.

This species is a rather variable shell, which in part accounts for the numerous synonyms. It extends throughout the Chesapeake Miocene, from Maryland to Florida, passes into the Pliocene and Pleistocene, and extends in the living state from Massachusetts Bay southward to Florida, and westward to Vera Cruz, Mexico.

The species from the Chesapeake Miocene in the National Collection, without exception, belong to the variety *percallosa* Conr., which has the umbilicus filled with callus; the Pliocene specimens I have examined are all typical *duplicata*, in which the umbilicus remains partly free from callus. The recent specimens offer both varieties in abundance. I note in the recent shells, of which I have examined a very large number from all parts of the coast, that the tendency, other things being equal, is for the southern specimens to have a depressed form and wide umbilicus with a relatively small amount of callus. The variety *campeachiensis* represents the extreme of this tendency, all gradations being observable in a collection of specimens covering a sufficiently wide geographical range. The usual differences exist between the sexes, the male being smaller, more conical, generally with a proportionately higher spire and darker-colored, though the color also varies with the ground on which they live; specimens from a clean sand-beach are always lighter-colored, generally less elevated and larger than specimens from a muddy shore. The small, elevated dark males were described by Dr. Gould as *N. fossata*. A depressed but well-grown female accords with Conrad's *N. Emmonsii;* his *N. densata* is an equally well-grown male. Exactly similar mutations exhibit themselves in the Pacific Coast species, *N. Recluziana* Desh., which is otherwise very nearly related to *N. duplicata*. *N. Recluziana* extends to the Miocene on the Pacific, and it has been described under several names, such as *N. inezana* and *N. ocoyana* Conr., and perhaps *N. saxea* Conr. and *N. callosa* Gabb.

Natica Milleri Gabb, from the figure, might be a *Neverita*. It is from the Miocene of Costa Rica. *Sigaretus numismalis* Gabb also greatly resembles a small *Neverita* which has accidentally lost its callus.

Subgenus **Lunatia** Gray.

Lunatia Gray, P. Z. S. 1847, p. 149. Type *N. ampullaria* Lam.
Naticina Fischer, Man. Conch., p. 766, 1885, not of Guilding, Trans. Lin. Soc. v. p. 31, 1834.
Natica Risso, not of Lamarck.

In describing his genus *Naticina*, Guilding describes *N. lactea* of the West Indies as its type. This species was indicated by Dillwyn under the name of *Nerita mammilla* var. B, to which *Nerita nitida* Donovan was wrongly referred as a synonym. Herrmannsen therefore cites *Natica nitida* Don. as the type of *Naticina*, supposing Dillwyn's synonymy to be correct. This seems to have misled Dr. Fischer, who knew Donovan's species to be a *Lunatia*, into supposing that the type of *Naticina* Guilding was a *Lunatia*, and, therefore, that Gray's name, being later, must be given up. But Guilding's type forms a link between *Polynices* proper and *Mammilla*, the umbilicus being usually open and the shell moderately thin; but occasionally the former is solidly filled with callus and the shell is thick, so that it cannot be distinguished from a typical *Polynices*. Therefore, we are not obliged to reject Gray's name, which has become so familiar for the type to which it was applied.

The fossil species which appear to be referable to *Lunatia* are often puzzling from their relations to the other subgenera, especially in the Eocene, so that it cannot be positively asserted that in all cases our conclusion is final. But, under the circumstances, it seems best to refer to *Lunatia* all those fossil species having the general form of the recent species of *Lunatia*, and of which the opercula are unknown. The number in our Tertiary is quite considerable, and several of them show traces of affinity with typical Naticas, which among the recent species have vanished. The groups which are sharply limited in the recent fauna blend into one another as we trace their ancestry—as has already been noted by Zittel and others; a result at which no evolutionist will feel surprise.

Omitting the Pacific Coast species, the Eocene forms of our Tertiary may be briefly summarized as follows:

L. newtonensis Meyer and Aldrich (1886) is known by its small, depressed spire, appressed suture, flattened and shouldered last whorl, solid shell and small umbilicus; it is known from Prairie Creek and Lisbon, Ala., Newton, Meridian, Enterprise, and the Wahtubbee Hills, Miss. It has been figured by De Gregorio under the name of *semilunata* Lea, which latter species he has not recognized.

L. minima Lea is a thinner shell than the preceding and more elevated; its prominent characters are its rounded whorls, deep suture, its excavated and often spirally striated umbilicus, with the pillar thickened only near the body, and very little reflected there. It reaches an altitude of 19 and a breadth of 20 mm., and is known from Claiborne, Wahtubbee Hills, Wood's Bluff, etc., and is especially abundant in the Jackson horizon. A species named *L. Tuomeyi* by Prof. Whitfield, from the Old Miocene marl of Jericho, N. J., does not seem to differ from *L. minima*, except, perhaps, in not reaching so large a size as the majority of Eocene specimens. Lea's type is a very young shell, but recognizable. De Gregorio figures an extremely minute young shell under the varietal name of *pusilliuscula*, but I cannot see why it should have been named.

L. perspecta Whitfield (1865) is of about the same size as *L. minima*, from which it differs by its somewhat smaller umbilicus, more polished surface, and by having a spire like that of *Neverita duplicata* in miniature. The suture is usually minutely channelled. We have it from the Prairie Creek beds, Matthews' Landing, and Claiborne, Ala.

L. vicksburgensis Conrad (1848) is a shell of the shape of the recent *L.*

triserata Say, but with a larger, though somewhat variable, umbilicus. It is more elevated and larger than *perspecta*, and almost invariably has a little notch or groove on the upper reflected part of the pillar. *L. decipiens* Meyer (1885) and probably *L. marylandica* Conrad (1865) are synonyms. The latter is doubtfully from Maryland. We have *L. vicksburgensis* from many localities in the Vicksburg beds in Mississippi, and from Alabama, White Bluff, Arkansas, the Prairie Creek beds and the Jacksonian. One of our specimens has had the aperture symmetrically filled up, leaving a central opening of uniform caliber, as in Mr. Aldrich's *Expleritoma* and Dr. Meyer's *Castellum*. From the close similarity of the operation to the work of certain recent Annelids, which fit dead shells for their habitations in this manner, I am convinced that these Eocene shells have been similar harbors of refuge, and consequently that we shall have to give up the genera founded on this state of things. The thickening is done so evenly and neatly that it is difficult to detect the junction between the secretions of the Annelid and the Mollusk respectively, but in the recent shell they are at once distinguishable by their color.

L. parva Lea is a curiously elongated species with appressed whorls, and notable for its deep, narrow umbilicus, carinated at the outer margin, and the pillar thin and excavated by the umbilicus. It never reaches the size of the last species. Conrad's *N. eminula* doubtless belongs here, but De Gregorio's *N. parva* is another species, probably a variety of *N. minor* Lea. *L. parva* is a characteristic Claibornian fossil. I have seen it also from White Bluff, Jefferson County, Ark., and from the Eocene of the Sepulga River, Alabama.

There are several undescribed forms in the Prairie Creek beds Heilprin has described a *N. Dumblei*, probably a *Lunatia*, from the Eocene of Texas. According to Prof. Heilprin, *L Moorei* Gabb is founded on a small specimen of *N. minor* Lea. *Natice eborea* Conrad (in Morton, Syn. Org. Rem.) is *Dillwynella naticoides* Lea. *N. lisbonensis* Aldrich I have not seen.

The Miocene species are less numerous, yet the group is well represented, and the shells are of considerably larger size in most cases.

Polynices (Lunatia) hemicryptus Gabb.

Natica hemicrypta Gabb, Journ. Acad. Nat. Sci. Phila., 2d Series, iv. p. 375, pl. 67, fig. 5, 1860; Conrad, Am. Journ. Conch. iv. p. 66, pl. 6, fig. 1 (fig. 7 excl.), 1868; Whitfield, Gastr. N. J. Miocene Marls, pl. 22, figs. 1-5.

Lunatia eminuloides Gabb, Journ. Acad. Nat. Sci. Phila., 2d Ser. viii. p. 339, pl. 44, fig. 4, 1875.

Not *N. hemicrypta* Conrad, Am. Journ. Conch. iv. pl. 6, fig. 7, 1868.

? *Natica caroliniana* Tuomey and Holmes, Pleioc. Fos. S. C., pl. 25, fig. 18.

Older Miocene of Shiloh and Jericho, N. J., Gabb and Burns; of the Chipola beds near Bailey's Ferry, Chipola River, Calhoun Co., Florida, of the Orthaulax bed at Ballast Point, Tampa Bay, Florida; and of Sapote, Costa Rica, Gabb.

This small species, first described by Gabb, was afterward confounded with his *Natica caroliniana* by Conrad, and subsequently reinstated by him, while he figures as an adult specimen an individual of a distinct species. It grows to the height of half an inch, and would seem to be the depauperate representative in the Miocene of *N. vicksburgensis* of the later Eocene. The specimens from the Chipola beds are in a much better state of preservation than those from the New Jersey marls. That from Costa Rica figured by Gabb under the name of *eminuloides* does not seem to differ materially from a well-grown *hemicrypta*.

Polynices (Lunatia) internus Say.

Plate 20, figure 7.

Natica interna Say, Journ. Acad. Nat. Sci. Phila., 1st Ser. iv. pp. 125-6, pl. vii. fig. 1, 1824.
Natica heros Tuomey and Holmes, Pleioc. Fos. S. C., p. 114, pl. 25, figs. 15 a, b, 1857; not of Say.
Natica heros Conrad (*ex parte*), Proc. Acad. Nat. Sci. Phila. for 1862, p. 565, etc.
Natica catenoides Conr. (*pars*), *non* S. Wood, Proc. Acad. Nat. Sci. 1862, p. 565.
Natica heroica Dall (MSS.), this paper, p. 213; name only.

Chesapeake Miocene of St. Mary's River, Maryland, of Wilmington, North Carolina, and of South Carolina; Pliocene of the Waccamaw beds, S. Car., Johnson.

While Say's figure of his *Natica interna* is very bad, yet, taken in connection with his description, I have concluded it can refer only to the present species, and therefore withdraw the manuscript name which I had intended to apply to it.

The Miocene *Naticidæ* of our Tertiary have hitherto been in a good deal of confusion, partly owing to their poor state of preservation. In the present group, beside *L. hemicrypta*, I recognize, after studying a large mass of material, three species with well-marked characteristics, and easily separated when once discriminated. They are: *L. interna*, *L. caroliniana* Conr. (*pars*) and *L. heros* Say. Conrad confused all together for a long time, then named *L. caroliniana*, but seemed afterward to forget which of the three he had separated, and applied the name *caroliniana* to each in turn and also to *L. hemicrypta*, and finally capped the climax by describing an entirely distinct Cretaceous species from North Carolina under the name of *Lunatia carolinensis*. For a time also he seems to have confounded *L. interna* with *N. catenoides* of the British Crag. Under the circumstances, it is fortunate that the original *caroliniana* Conrad (1841) had previously been described by the brothers Rogers, under the name of *perspectiva*, so that Conrad's name may be entirely expunged from the lists.

Lunatia interna may be discriminated by its low spire, its full and rounded whorls, and by the characters of the umbilicus, which shows a marked sulcus ascending spirally below a thickened, obscure rib, which are respectively indicated in mature and perfect specimens by an emargination and a callus on the pillar-lip. It has six or eight whorls, and attains a breadth of 26 and a height of 28 mm.

Polynices (Lunatia) perspectivus Rogers.

Natica perspectiva Rogers, Trans. Am. Phil. Soc., 2d Ser. v. p. 332, 1837; *ibid.* vi. pl. xxvi. fig. 3, 1839.

Natica caroliniana Conrad, Am. Journ. Sci. xli. p. 346, pl. 2, fig. 18, 1841; Am. Journ. Conch. iv. p. 65, pl. 6, fig. 3, 1868.

Not *N. caroliniana* Tuomey and Holmes, Pleioc. Fos. S. C., pl. 25, fig. 18, nor of Conrad, Proc. Acad. Nat. Sci. Phila. 1862, p. 564, 1863.

Chesapeake Miocene of St. Mary's River and Plum Point, Md., of Williamsburg, Va., and of Duplin County, N. Carolina.

This is *N. heros* Conrad, *ex parte*, *non* Say, and *N. hemicrypta* Conrad, *ex parte*, not of Gabb. The species is much the same shape as *L. triseriata* Say, of the recent fauna, but larger, heavier, and with a different umbilicus. It may be recognized by its smoothly arched spire, in which the rotundity of the whorls is not marked and the suture is smoothly appressed, as in a male *Neverita duplicata* of the elevated variety; by its umbilicus, which is wide below and obscurely spirally striate, with near the top of the umbilical wall a sharp narrow spiral rib, which terminates between two obscure notches on the columellar callus. It is a narrower, heavier and smaller shell than the average adult *L. heros*, though decorticated specimens, such as abound in the marls, are sometimes difficult to recognize. Conrad's figures (Am. Journ. Conch. iv. pl. 6, fig. 3, etc.) are bad, representing immature and depressed specimens, and exaggerating the size of the umbilicus and the spiral rib.

Polynices (Lunatia) heros Say.

Natica heros Say, Journ. Acad. Nat. Sci., 1st Ser. ii. p. 248, 1822; Gould, Inv. Mass., p. 231, fig. 163, 1841.

Lunatia heros Dall, Bull. 37 U. S. Nat. Mus., p. 154, pl. 51, figs. 1, 11, 1889.

Chesapeake Miocene of Jones's Wharf, St. Mary's River, and Little Cove Pt., Maryland, and various points in Virginia; Post-Pliocene of Massachusetts, at Sankoty Head, and living on the eastern coast of the United States from Labrador to Hog Island, Virginia, in 1 to 238 fathoms.

This species does not appear to have extended its range south of North Carolina, the citations for more southern localities referring usually to *L. interna* or *perspectiva*. The form, which may, perhaps, be a distinct species, *L triseriata* of Say, I have not been able to recognize among the fossils, though Verrill reports it from the Post-Pliocene of Sankoty Head.

This species is somewhat variable, and the difference between the sexes is very marked. In a pair from Nova Scotia having each a height of 50 mm. the male measured 40 mm. in maximum diameter and the female 45 mm. The difference in form is even greater than these measurements would imply. The deep-water specimens are thin, but grow to a very large size. This species is especially subject to decortication in the fossil state, and when so mutilated is difficult to recognize. Perfect adult specimens can usually be identified by their globose form, rounded but not turrited whorls, small ribless umbilicus and feeble callus. The young resemble *L. interna*, but want the umbilical rib, though it is sometimes quite difficult to separate immature specimens.

Other species of *Lunatia* known from our Tertiary on the Pacific Coast are *L. nuciformis* Gabb, from the Eocene; *L. alveata* Conrad, which, however, may be an *Amauropsis; L. oregonensis* Conrad, from the Astoria Miocene, and *L. Lewisii* Gould, the largest species of the group, which extends from the recent to the Pliocene fauna. *L. gronlandica* Beck, an Arctic species, is found in the northern Post-Pliocene on both sides of the continent.

Genus ? AMPULLINA (Lamarck) Bowdich.

Section *Ampullina* s. s.

Ampullina streptostoma Heilprin.

Natica streptostoma Heilp., Trans. Wagn. Inst. i. p. 112, pl. 16, fig. 51, 1887.

Jacksonian Eocene of the white limestone at Claiborne, Alabama, Whitfield; Old Miocene of the Orthaulax bed at La Penotière's Hammock and Ballast Point, Tampa Bay, Florida.

This form is closely related to *Ampullina sigaretina*, from which it appears to differ by its wider basal callus and more open umbilicus. I have not had sufficiently good or sufficiently abundant material from Ballast Point to enable me to discuss the species with confidence.

Ampullina Fischeri n. s.

Plate 22, figure 36.

Old Miocene of the Chipola beds, near Bailey's Ferry, Chipola River, Calhoun Co., Florida.

Shell closely related to *Ampullina sigaretina* of the Parisian Eocene, from which it differs by its somewhat more depressed spire, less impressed suture, wider basal fasciole, and by the thick, complete coat of callus, which in the adult covers completely the fasciole and umbilicus, as in *Cernina fluctuosa*. The shell is also slightly less expanded and rounded than the European fossil. It has a low but pointed spire, six or seven whorls, smooth surface with impressed incremental lines, slightly flattened callus, and in front of the suture the whorl is flattish instead of rounded, as in *A. sigaretina*. A shell of six whorls measures 33 mm. high and 38 mm. in maximum diameter, but I have fragments which measure over 60 mm. in diameter.

This form was at first regarded by me as being merely a mutation of *A. streptostoma*, but of more than twenty-five specimens from various localities which were in a state to show the base, not a single one has an open umbilicus, while all the Ballast Point and Claibornian specimens have the umbilicus open. The young of both are not separable. It may eventually prove to be a local race of *A. streptostoma*, but at present would seem better kept apart.

It is respectfully dedicated to Dr. Paul Fischer, of Paris, the distinguished paleontologist and malacologist.

Section *Ampullinopsis* Conrad.

Ampullinopsis Conrad, Am. Journ. Conch. i. p. 27, 1865.
Megatylotus Fischer, Man. de Conchyl., p. 766, 1885.

As Conrad's name was not defined, it is probable that the later name of Fischer should be adopted.

Ampullina crassatina Lam. var. **mississippiensis** Conrad.

Natica crassatina Deshayes, Descr. Coq. Par. ii. p. 171, pl. xx. figs. 1, 2, 1825; De Greg., Mon. Claib., p. 148.
Ampullaria crassatina Lam., Ann. du. Mus. v. p. 33, viii. pl. 61, figs. 8 a, 8 b; An. s. Vert. vii. p. 550.
Natica mississippiensis Conr., Proc. Acad. Nat. Sci. iii. p. 283, 1847; Journ. Acad., 2d Ser. i. p. 114, pl. 11, fig. 10, 1848; De Greg., Mon. Claib. Eoc., p. 148.

Eocene of Bell's upper and Gregg's Landing, Alabama (Aldrich); of Claiborne (?) De Gregorio; Carson's Creek, Wayne County, Miss. (Red Bluff Group), Burns; lowest bed at Vicksburg, Miss., Burns. The type is found in the upper sands of Fontainebleau, in the Parisian, and in the Eocene and Older Miocene of France, Germany, and even the Crimea. It appears to be omitted in M. Cossmann's excellent monographic list, and the above localities are given on the authority of Deshayes.

Conrad's figure of his shell is abominable, and De Gregorio's are not very good. The shell, on comparison of specimens, differs from the French form by being somewhat narrower and more elevated, and in wanting any trace of the fine spiral striation which is found on the French specimens. The umbilicus is almost always closed, but specimens with an open chink do occur occasionally. It reaches a height of 65 and a breadth of 45 mm. I do not see any characters in the American shell which may not be varietal, if we regard the Parisian species as the type. I have examined about forty specimens, mostly well-grown. De Gregorio does not specify where his specimens came from. I have not seen any from the Claiborne sands.

Ampullina amphora Heilprin.

Natica amphora Heilprin, Trans. Wagner Inst. i. pp. 112, 120, pl. 16, fig. 50, 1887.

Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, Stearns, Heilprin, etc., and of the Tampa limestone, Tampa City, Dall.

This fine large species seems to bear to the var. *mississippiensis* such a relation as the *A. maxima* of the French Older Miocene does to the typical *crassatina*. In all the specimens I have seen, old or young, the umbilicus opens by a very oblique aperture or fissure. The basal fasciole is narrower and defined by a more distinct line than in *mississippiensis*, from which, otherwise, it can be separated only with great difficulty.

Ampullina reversa Whitfield.

Natica reversa Whitfield, Am. Journ. Conch. i. p. 264, 1865.

Eocene of Prairie Creek, Wilcox County, Ala., of the Sepulga River and Matthews' Landing, Johnson and Aldrich.

This species is a very remarkable form. The whorls are round and inflated, and the suture extremely deep, though not channelled. The umbilicus is ample, and bounded at the left by a strong, elevated, rapidly enlarging rib, which stands up from the base of the shell like the siphonal fasciole of a *Nassa*. It is, however, solid, and terminates at the inner anterior part of the aperture in a large, blunt, subtriangular callus. Above this rib the pillar is thin, sharp-edged and emarginate, rising again to meet the thick callous deposit on the body-whorl. The wall of the umbilicus is somewhat excavated. In the adult shell this rib is relatively feeble, and transversely imbricated by coarse lines of growth. In the young the surface is polished and smooth. The species somewhat resembles *A. recurva* Aldrich, which is a larger shell, with the umbilical rib higher up, with a shallow sulcus outside of it, and the sides of the last whorl somewhat flattened anteriorly.

Ampullina solidula n. s.

Plate 22, figure 31.

Older Miocene of Ballast Point, Tampa Bay, in the Orthaulax bed, Dall.

Shell small, thick, of about six nearly smooth whorls, marked only by lines of growth; apex small, pointed; suture distinct; the whorls flattened for a short distance in front of it, then amply rounded; base convex; umbilicus moderate, deep, bounded by an elevated, narrow rib, inside of which the surface is striated in harmony with the lines of growth; aperture rounded in front, the pillar-lip thin, emarginate opposite the umbilicus, not reflected; body with little or no callus; outer lip oblique, arched internally, thickened and slightly expanded at the extreme edge. Alt. of shell 16; max. diam. 17 mm.

The single specimen obtained is obviously different from any of the species hitherto described. It is a much more solid shell than *A. streptostoma* of the same size and has a different umbilicus.

In taking leave of this group, it may be observed that De Gregorio refers part of the species to *Euspira* Agassiz, which is generally regarded as synonymous with *Ampullina*, and refers to it *Neptunea enterogramma* Gabb. The latter, from the figures, is a siphonostomate shell, and it seems singular to find it referred to a genus like *Natica*.

The group has been so generally regarded as of generic rank that I have left it so with a query, but I am tolerably confident it should be reduced to the rank of a subgenus with the others.

Subgenus **Lacunaria** Conrad.

Lacunaria Conrad, Am. Journ. Conch. ii. p. 77, 1866. Not of Dall, 1884.

This group, while obviously related to *Ampullina*, differs in the absence of callus on the base, by the acute spire, tendency to sculptural striation of the whorls, and generally small size. They are so far all Eocene species, and include *A. alabamiensis* Whitfield, the type, and *A. erecta* Whitfield, of which *Natica* (*Euspira*) *promovens* De Gregorio is probably a very young specimen.

Subgenus **Amauropsis** Mörch.

This group has a normally naticoid animal, but *Amaura* Möller has an animal with particular characters of its own, separating it generically from *Natica* or *Polynices*. Notwithstanding this, *Amaura* and *Bulbus* (or *Acrybia*, which is again a true *Polynices*, differing at most subgenerically from the latter) and *Amauropsis* are generally lumped together as a group by themselves in the systematic manuals, etc. This illogical proceeding seems to have resulted chiefly from the fact that the recent species are all Arctic shells.

Polynices (Amauropsis) perovatus Conrad?

Ampullaria? perovata Conr., Proc. Acad. Nat. Sci. iii. p. 21, pl. 1, fig. 16, 1846.
Lupia perovata Conr., Am. Journ. Conch. i. p. 27, 1865; Smithsonian Eoc. Checklist, p. 15.
? *Natica* (*Euspira*) *propeconica* De Greg., Mon. Claib., p. 153, pl. 15, figs. 7 a, 7 b, 1890.

Claibornian Eocene, Conrad and De Gregorio; "white limestone" of the Jacksonian at Claiborne, Alabama, Whitfield; Newer Eocene of the Ocala limestone at Ocala, Florida, Willcox; and Older Miocene of Chipola River, Calhoun Co., Burns.

De Gregorio's figure, if I have correctly identified his species, is not very good, as the sutures are more distinctly and widely channelled than his drawings indicate, and therefore, in profile, have a more turrited look. The shell is thin, imperforate, smooth, with a thin callus on the pillar and a narrow fasciole behind the pillar which recalls *Ampullina*. There can be no doubt of the identity of the specimens before me as one and the same species, but it is possible that De Gregorio's type may be different, in which case our present form may take the name of *ocalana*. Conrad's figure is very poor, yet I think the chances are in favor of the correctness of the identification.

Polynices (Amauropsis) Burnsii n. s.

Plate 22, figure 33.

Older Miocene of the Chipola River, one mile below Bailey's Ferry, Calhoun Co., Florida, Frank Burns.

Shell ampullariæ-form, solid, smooth except for periodically impressed lines of growth; with seven or eight whorls; apex depressed, minute, pointed; suture distinct, with a wide channel in front of it; whorls in front of the channel evenly rounded, full, and smooth; base rounded, imperforate, the pillar with a very narrow fasciole; aperture subovate, not very oblique, the lips thickened and reflected, joined over the body by a continuous callus. Alt. of shell 18; max. diam. 15 mm.

This elegant shell resembles the preceding species, but is much more depressed, smaller and more callous around the aperture. The other species from Ballast Point has no channel in front of the suture and a much less callous aperture.

Polynices (Amauropsis) Guppyi Gabb?

Amaura Guppyi Heilprin, Trans. Wagn. Inst. i. p. 112, 1887.
? *Amaura Guppyi* Gabb, Trans. Am. Phil. Soc. xv. p. 224, 1873.
? *Natica phasianelloides* Guppy, Quart. Journ. Geol. Soc. xxii. p. 219, pl. 17, fig. 1, 1866.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Dall and Willcox.

Gabb says of his species that the spire is two-thirds as long as the mouth, and that the whorls are rounded, neither flattened nor channelled near the suture. He also says that Guppy's figure is a little smaller than the average of the full-grown specimens. Guppy's figure shows the whorls rounded and without any channel or turriculation.

In the Florida shell, all the specimens examined have the whorl in front of the suture distinctly flattened, and the spire averages about one-half of the length of the mouth. The average size is comparatively larger than Guppy's figure, though this is not very important. Still, these differences suggest a misidentification, as Professor Heilprin had only one specimen for comparison. If the species prove distinct from the Antillean shell, it may take the name of *floridanus*.

It may be noted that *Bulimus limnæiformis* Meek and Hayden, of the Fort Union Lignitic group, has a very close resemblance to the elevated forms of *Amauropsis* or *Amaura*, suggesting a doubt as to its generic place. *Amaura tornatelloides* Meyer, from the Claibornian, is probably not an *Amaura*, and may be an *Onoba*.

Genus **SIGARETUS** Lamarck.

This group is represented in our Tertiary from the Eocene onward by species of *Eunaticina*, as well as typical *Sigaretus*.

In the Eocene we have *S. bilix* Conrad (+ *striata* Lea), which is a conical, almost naticoid, species very abundant in the Claibornian, and found also in Lee County, Texas, at Wood's Bluff, Ala., and Red Bluff, Wayne County, Miss. It is represented in the Jacksonian and Vicksburg group, where it was named *mississippiensis* by Conrad. At first I supposed that the Vicksburg form might be varietally separated from that of Claiborne by having a somewhat smaller umbilical opening, and, in general, perhaps this is true; yet in examining a large quantity of Claibornian specimens, I find the umbilicus varying quite as much among them as the most extreme Vicksburg specimens do from the average Claibornian.

Another form is well represented in the Claiborne sands, which was named *S. declivis* by Conrad. It is readily separated from *S. bilix* by its more depressed form, a wide emargination of the pillar, and the roofing over at the upper end of the umbilicus by an extension of the body-callus. All De Gregorio's figures of "*S. striata* Lea," except figure 9, plate 15, represent *S. declivis*. We have it also from Wood's Bluff, Ala.

Sigaretus arctatus Conrad, a small, depressed species, with a thin edge to the pillar, only reflected near the upper end, is known from Claiborne and Vicksburg, Miss.

S. inconstans Meyer and Aldrich is another small, depressed species, with the form of *Haliotis asinina*. It is known from Claiborne and Newton, Miss., and the vicinity of Darlington, S. Car.

In the Miocene, beside those about to be more fully referred to, we have *S. fragilis* Conrad (+ *apertus* H. C. Lea), from the Chesapeake Miocene of Maryland and Virginia; and *S. multilineatus* Gabb, from the Miocene of Costa Rica. *S. numismalis* Gabb, from the same horizon, may prove to be a broken *Neverita*. *S. perspectivus* Say, well known as a recent shell, as a fossil does not appear to antedate the Post-Pliocene.

Sigaretus chipolanus n. s.

Plate 17, figure 7.

Older Miocene of the Chipola beds, Calhoun Co., Florida, Burns; and of the Orthaulax bed at Ballast Point, Tampa Bay, Dall.

Shell solid, rather thick, varying in rotundity with age, the young ones as a rule being more naticoid in shape, while the more advanced are relatively flatter, and the fully mature specimens again are more rotund; whorls four or five, sculptured with rather fine, flattish, revolving threads of varying size, separated by channelled interspaces, varying in width and minutely undulated or reticulated by the sharp, close-set, fine incremental lines; aperture large, oblique; base somewhat flattened, periphery rounded; pillar-lip arched, broad, flattened somewhat and sometimes excavated, with a narrow sulcus behind it, running up to the imperforate umbilical region; callus on the body moderate, lip not reflected. Max. lon. of adult 33; diam. 27 mm.; lon. of young shell 16.5; axial elevation 11; diam. 15 mm.

This species is most nearly related to *S. declivis*, from which it may be separated by its closed umbilicus and the absence of the emargination of the pillar, which is the most characteristic feature of *declivis*. It also recalls *S. bilix var. mississippiensis*, which has a perforate umbilicus and is more rotund. The specimen figured is from the silex-beds; the much larger and more characteristic specimens from Chipola were only obtained later. The sculpture may be close or sparse; it varies in this respect in nearly all the species.

Sigaretus multiplicatus n. s.

Plate 20, figures 12, 12 b.

Pliocene of the Waccamaw River, S. Carolina, Johnson, and of the Caloosahatchie beds, Florida; Willcox.

Shell depressed, with a smooth nucleus of two whorls, in all with four or five whorls, a distinct suture, and the usual spiral striation somewhat undulated by the incremental lines; periphery rounded, base flattened and even a little concave between the pillar and the periphery; aperture large, subquadrate, the pillar-lip thin, not reflected, but with a wash of callus from the body laid over the upper end; umbilicus imperforate. Alt. of young shell 10; diam. 16.5 mm.; max. lon. of shell 17 mm.; max. lat. of adult 43.75; alt. 20 mm.

This fine large species appears to be quite rare in the Pliocene, and is the forerunner of such species as *S. maculatus* of the recent fauna.

Subgenus **Eunaticina** Fischer.

Eunaticina Fischer, Man. Conchyl., p. 768, 1885.
Sigatica Meyer, Cincin. Journ. Nat. Hist. 1886.
Naticina Gray, 1842, not of Guilding, 1834.

Sigaretus (Eunaticina) Conradii Dall.

Narica mississippiensis Conr., Journ. Acad. Nat. Sci. Phila., 2d Ser. i. p. 113, pl. 11, fig. 8, 1848.

Vicksburg Eocene of Mississippi.

The shell figured under the name of *Narica* by Conrad is a well-defined *Eunaticina*, and since there is already a *Sigaretus mississippiensis* of the same author, I propose for this one the name of *Conradii*.

Sigaretus (Eunaticina) carolinensis Dall.

Eunaticina carolinensis Dall, Rep. Blake Gastr., p. 297, 1889.

Pliocene of the Caloosahatchie beds, Florida, Dall; and living off the coast of North Carolina in 63 to 124 fathoms, U. S. Fish Commission.

The fossil specimens differ from the recent ones only in having fewer spiral striæ just in front of the suture, but this is a very inconstant character, and only two specimens of the fossil have been collected, so there is no reason to doubt their identity.

Another species of the group still found living in shallow water on the west coast of Florida is *Eunaticina semisulcata* Gray (+ *Fordii* Simp.). It is not yet known as a fossil. In the Eocene we have *S.* (*Eunaticina*) *Boettgeri* Meyer and Aldrich, and *S. Clarkeanus* Aldrich, the former from Newton and Lisbon, Miss., the latter from Choctaw Corners and Hatchetigbee Bluff, Ala. From the Miocene of Sapote, Costa Rica, Gabb has described a *Natica sculpturata* which probably belongs hereabouts.

On the western coast there are *Sigaretus scopulosus* Conrad, Astoria, and *S. obliqua* Gabb. *Lysis* Gabb, which has been supposed to belong in this vicinity, is perhaps more likely to be related to *Fossarus*. In the transitional Chico-Tejon beds there are a good many species related to *Sigaretus*, etc.

Superfamily DOCOGLOSSA.

FAMILY ACMÆIDÆ.

Genus ACMÆA Eschscholtz.

Acmæa punctulata Gmelin.

Patella punctulata Gmel., Syst. Nat. xiii. p. 3705.
Acmæa punctulata Dall, Bull. 37 U. S. Nat. Mus., p. 156, 1889; Pilsbry, in Tryon Man. xiii. pp. 37-8, pl. 5, figs. 99, 100, 1-6, 11-13, 1891.

Pliocene of the Caloosahatchie, Dall, rare; living from the Florida Keys southward through the Antilles.

This is the *A. pustulata* Helb., *A. cubaniana* of Orbigny, *A. confusa* and *pulcherrima* of Guilding. It is the only true limpet yet discovered in the Atlantic Pliocene, and, in fact, as far as I know, from our whole Tertiary period, though *A. testudinalis* Linné, *Lepeta cæca*, and possibly *Acmæa fulva* Fabr., are known from Post-Pliocene beds in the northern portion of the continent.

Superfamily RHIPIDOGLOSSA.

FAMILY PHASIANELLIDÆ.

Genus PHASIANELLA Lamarck.

Phasianella pulchella C. B. Adams.

Turbo pulchellus Ads., Synops. Sh. Jamaica, Proc. Bost. Soc. Nat. Hist. ii. p. 7, 1845.
Phasianella brevis Adams, not of Orbigny.
Phasianella pulchella Dall, Blake Report Gastr., p. 351, 1889.

Pliocene of the Waccamaw River at Tilly's Lake, South Carolina, Johnson; living in the Antilles and the Florida Keys, and northward to Cedar Keys, West Florida.

The young have quite a strong umbilical rib, which sometimes results in a small sulcus at the margin of the aperture, and in the fossils gives them an aspect which at first seems quite different from *Phasianella*. But this feature is exceptional and not persistent in the same individual.

Phasianella brevis Orbigny.

Phasianella brevis Orb., Moll. Cuba, ii. p. 79, pl. xx. figs. 19, 21, 1842, not of Adams, 1850; Dall, Bull. 37 U. S. Nat. Mus. p. 158, pl. 19, fig. 10 b, 1889.

Older Miocene of the Chipola beds, Calhoun Co., Florida, Burns; living from Cape Hatteras to Martinique in moderate depths of water.

This species will undoubtedly be found in the Pliocene of the Caloosahatchie when thoroughly searched. It agrees in all respects with the recent shells, passing through the same series of variations, and even possessing the same color-pattern, as indicated by the surface-erosion of the shell, where, as is well known, the spots originally occupied by dark color-markings decay before the rest of the surface.

Phasianella affinis C. B. Adams.

Phasianella affinis C. B. Adams, Contr. Conch., p. 67, 1850.

Older Miocene of the Chipola beds, with the last species, living on the coast of Honduras and in the Antilles, Simpson, Adams, etc.

This species is in the same position as the last, and will probably be found in the Pliocene at some future time, though it is possible that the influx of cold water at the beginning of the Chesapeake or later Miocene drove the species so far south that it never recovered its lost ground. It has not been found as yet in the Florida Keys, and its most northern continental station yet reported is on the coast of Honduras. The color-pattern is the same in both the recent and fossil shells.

Phasianella umbilicata Orbigny is found in the older Miocene of Bowden, Jamaica, as well as in the recent fauna. *P. compta* Gould is reported from the Post-Pliocene of the Pacific Coast.

FAMILY TURBINIDÆ.

Genus **TURBO** Linné.

Section *Senectus* Swainson.

Turbo crenorugatus Heilprin.

T. crenorugatus Hp., Trans. Wagner Inst. i. p. 113, pl. 16, f. 54, 1887.

Orthaulax bed at Ballast Point, Tampa Bay, in the older Miocene, Willcox, Burns and Dall.

This shell, from the descriptions, should be allied to *T. dominicensis* Gabb, a species of the same geological age described in 1873, but not figured, from the Miocene of Santo Domingo. It must reach a much larger size than that of the specimen described by Heilprin, since I have an operculum obtained by Mr. Willcox which measures 31 mm. in greatest diameter. The operculum is somewhat concave, showing more than six whorls on the inner side, and on the outside is rather evenly convex, with a fine superficial granulation.

Turbo castaneus Gmelin.

Turbo castaneus (Gmelin, 1788), Pilsbry, Man. Conch. x. p. 203, 1888.

Pliocene marl of the Caloosahatchie River and Shell Creek, Florida, Dall and Willcox; Post-Pliocene marl of Volusia Co., Fla., Wright; living on the coast from Cape Hatteras, N. C., to Trinidad, West Indies, in various depths from near 25 to 295 fathoms, U. S. Fish Commission, Hemphill, and others.

Turbo castaneus var. **crenulatus** Gmel.

This has the same range as the preceding in time, but is more commonly found in shallower water in the present seas, for the most part from low-water-mark to 30 fathoms.

This species varies in the Pliocene as it does in the present fauna. The operculum varies considerably in different individuals. As a rule, it is not evenly convex and smooth, as usually figured. Such a form I have observed only on a few occasions. Usually the inner side of the operculum is nearly flat, the outer side convex, with a wide, flat subspiral margin sharply impressed, and extending for three-fourths the circumference around the central convexity. This latter is also obscurely spiral, with a dimple or depression over the nucleus, where there is also usually a brown stain. At times there seems to be a deposition of callus over all this, and when that occurs the features above described are masked or obscured, but nine out of ten opercula which I have examined show the above-mentioned features, forming a transition to *Callopoma* quite as marked as that presented by *T. Spenglerianus.*

Section *Callopoma* Gray.

Turbo rheotogrammicus n. s.

Plate 18, figures 8 a, 11.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox.

Shell large, compact, rounded, with a rather elevated apex and about seven whorls. Some specimens show a mottled color-pattern of small white spots on a reddish ground not unlike the pattern observable in some specimens of *T. crenulatus* Gmelin, but the majority of the fossils have lost all their color. The first few turns when perfectly preserved are flat or concave above, strongly keeled at the periphery, with the suture some distance below the keel; remainder of the whorls spirally sculptured with rounded costæ, which increase by intercalation as the shell enlarges, and preserve their relative subordination in size, so that on the last whorl there are spirals of three or four sizes; the ridge next the suture is particularly strong, and the upper surface of the whorls in front of it is slightly constricted; the suture is distinct, but not channelled; across the spiral sculpture the incremental lines are elevated into fine lamellæ, which are most strongly marked between the ridges, though when perfectly preserved the whole surface bears them; the spiral in front of the suture, in the early whorls, is occasionally beaded, but as a rule the spiral sculpture, except as cut by incremental lines, is plain and uniform; the base is rounded, sculptured like the upper surface; pillar broad, excavated, with a prominent fasciole bounding the small, deep subcylindrical umbilicus, but not extended into a point below the aperture; outer lip thin, body with a moderate callus, grooved near the suture; throat without liræ, aperture evenly rounded. Alt. 46; max. diam. 47 mm.

Operculum recalling that of *C. fluctuosum* Wood in its main features, except that the narrow lirulæ outside of the principal spiral ridge are absent, and the space is, as it were, terraced up to that ridge, while the whole outer surface of the operculum is covered with irregularly disposed, often prickly, pustules.

This fine species is rather abundant in the Shell Creek Pliocene and not uncommon in the Caloosahatchie marl. In some respects it is intermediate between the sections of *Turbo* now recognized, and between *Turbo* proper and *Astralium*. Its nearest relative is a species now living on the western coast of Mexico, but it is also akin to both the Floridian species of *Senectus*.

Genus **ASTRALIUM** Link.

Subgenus **Lithopoma** Gray.

Astralium (Lithopoma) chipolanum n. s.

Plate 18, figure 6 a.

Older Miocene of the Chipola group, in the lower bed at Alum Bluff, Chattahoochee River, Florida, Burns.

Shell small, elevated-trochiform, with flattened sides and base and seven or eight whorls; nucleus minute, the first two or three whorls flattened above, coiled in a single plane, then taking on the adult habit in the remainder of the shell; periphery keeled, the carina furnished with ten or twelve triangular, imbricate spinose projections, underneath which the suture is closely appressed; above, between the suture and the periphery, are five low spiral, beaded bands, between which are single smaller intercalary threads, all of which march straight around the whorl without fluctuation; on the base between the periphery and pillar are about eight beaded spirals, alternated in strength; across the spiral sculpture, obliquely, especially toward the apex, run well-marked but not lamellose incremental lines; pillar narrow, arched, with a faint groove behind it, terminating in one or two feeble tubercles; aperture rounded quadrate, outer lip thin, body with a wash of callus. Alt. 11.5; max. diam. 11.0 mm.

This interesting little shell is without doubt the forerunner of the following species, but differs from it and from all the recent forms in the low rectilinear sculpture and the absence of any plications on the side of the whorl except at the periphery. The operculum is unknown.

Astralium (Lithopoma) precursor n. s.

Plate 18, figure 8.

Pliocene marls of the Caloosahatchie and Shell Creek, Florida.

Shell elevated, subacute, eight-whorled; nucleus small, smooth, of a single whorl; subsequent whorls sculptured with numerous subequal, flexuous, spiral threads, with narrower interspaces, crossed obliquely by numerous elevated, imbricated incremental lamellæ, so close-set that the entire surface when intact is densely scaly with minute flexuous, irregular scales; at right angles to the incremental lines the surface of the whorl is plicated from the suture forward with low irregular ridges, which frequently fail before reaching the periphery, and vary in number as well as in strength, generally being more numerous than the peripheral nodules; periphery rounded, pinched up into numerous (12 to 18) squarish nodules, with their vertical axes the longer, over which the smaller sculpture is continuous, and above which the whorl is somewhat contracted; base flattish, with four to six principal spirals and a narrow, elevated fasciole around the pillar, the whole covered densely with imbricated lamellæ like those of the spire; pillar arched, narrow, with a groove behind it, and bituberculate at the base; aperture rounded quadrate, simple inside, the outer margin somewhat crenulated by the sculpture; the periphery of the whorls overhangs the suture, and its nodules are rarely spinose except near the apex. Alt. of shell 35; max. diam. 28 mm.

Operculum with the inner side flat and exhibiting four or five whorls with an impressed line parallel with the suture; the outer side convex, with a deep pit over the nucleus and the remainder of the surface showing six or seven strong spiral, granular ribs separated by narrower, deeply-cut grooves, terminating at the surface of increment.

This species, while exhibiting in general much such a sculpture as *A. Olfersi* Phil., is really more closely related to *A. americanum*, to which I was at first disposed to refer it as a variety. The operculum found associated with it is, however, entirely different from either and more like that of *Callopoma*. There is, of course, a possibility that this operculum belongs to some undiscovered species of *Turbo*, though this seems unlikely, as the strata have been so carefully searched. As far as the shell is concerned, the average *A. precursor* differs from *A. americanum* by a more elevated and acute spire, by the flat rather than concave excavation of the upper surface of the whorls, by its more profuse and prominent surface-imbrication, by its coarser, more *Olfers*-like plications and peripheral nodes, by its narrower and less elevated umbilical fasciole without marked radiate sculpture, and by the smaller proportion of whorls with a spinose periphery to those which are nodulose. It would not be impossible to find specimens of *A. americanum* in which the characters above mentioned are singly approached, but on the whole the combinations are different, and there is no trouble in discriminating by the general aspect between the specimens of the recent and of the Pliocene fauna.

Astralium sp. indet.

Older Miocene of the Chipola beds, Calhoun County, Florida, Burns.

Several specimens of a young *Astralium* were collected by Mr. Burns from the Chipola beds which are not the young of *A. chipolanum*. They have four whorls, which are rather depressed, and carry at the periphery eight rather long and slender imbricated spines; the upper surface just in front of the suture, which is overhung by the preceding whorl, is pinched up or fluted with a number of short folds, forming a sort of band on the upper margin of the whorl; in front of this the surface is more or less covered with oblique, close-set, imbricated lamellæ, crossed by three or four fine spiral lines; the base is flattish, with four or five spiral, elevated, sometimes beaded, lines, and the umbilical carina is marked by two coarsely beaded spirals, the whole crossed by elevated, sometimes imbricated, radiating lines in harmony with the lines of growth. The base recalls that of *A. longispina* Lam., but the upper surface is quite different from that species. The specimens are about 5 mm. in greatest diameter and 3.5 mm. high. I have thought it best not to apply a name to these specimens, though they evidently represent a new species.

Genus **COLLONIA** Gray.

Collonia Gray, in Figs. of Moll. An. iv. p. 87, 1850, type *Delphinula marginata* Lam.
Tuba Gray, P. Z. S. 1847, p. 144. Not of Lea.
Collonia Gray, Guide Moll., i. p. 143, 1847; Carpenter, Proc. Cala. Acad. Sci. iii. p. 175, 1864. Not of H. and A. Adams, Gen. Rec. Moll. i. p. 396, 1854.

The fluctuations of the synonymy of this group have been recapitulated by Carpenter as above cited. The shells typified by *Delphinula marginata* Lam. carry the name. The species here figured and described have not afforded any specimens of the operculum, but they agree exactly in general character and especially in the features of the aperture, and I do not doubt their pertinence to the genus as above restricted.

The singular umbilical rib is reproduced in the young of sundry species of *Omphalius*, from the adult of which the same parts are markedly different.

I have not seen the operculum of the Parisian shell, and confess to some suspicion as to the combination of a thick, heavy calcareous operculum like that of *Callopoma* with the comparatively thin shell to which it has been assigned. But for the present I shall leave the group where Gray placed it, although its relations appear to be much more directly with such *Trochidæ* as *Omphalius*, or with the *Cyclostrematidæ*, judging by the shell alone.

The group appears first in the Claibornian, if I have correctly estimated the small species here described from thence. It also existed in the Chipola Older Miocene, disappeared during the Chesapeake refrigeration of these shores, and reappeared in the warmer Pliocene. No recent species are yet known from America.

The general form of the shells of this genus is more like an elevated *Cyclostrema* than a heavy turbinate *Omphalius*, and the outer lip is expanded and slightly thickened. The shell is small and relatively thin compared with *Omphalius*. The sulcus in the lip and the peculiar umbilicus forbid its association with *Cylostrema*, and the thickened and reflected lip distinguishes it from *Solariella*. It may perhaps bear to *Callopoma* somewhat such a relation as *Solanderia* does to *Gibbula*. From *Conradia* it is separated easily by its thickened and reflected lip; and from *Haplocochlias*, otherwise very similar, by its umbilical characters.

Collonia elegantula n. s.

Plate 19, figures 3, 4.

Newer Miocene of the Cape Fear River, North Carolina? Johnson; Pliocene of the Caloosahatchie beds, Dall; and the Myakka River and Shell Creek, Willcox.

Shell small, rather elevated, with a smooth, one-whorled, minute nucleus and three subsequent spirally sculptured whorls; whorls shouldered by a more or less evident obtuse keel above, obsolete toward the aperture; early whorls more coarsely, later ones finely evenly spirally grooved above and below; base amply rounded; umbilicus very minute, margined by a stout rounded striated rib; aperture rounded, pillar broad, arched, sulcate at the base opposite the umbilical rib, with a prominent pustule above and a smaller one below the sulcus; outer lip reflected and thickened in the adult, smooth within, joined to the pillar by a thin callus in the adult. Alt. 4.25; max. diam. 4.5 mm.

The specimen from the Cape Fear River may possibly have been derived from adjacent Pliocene beds. Some young specimens show a considerably coarser spiral sculpture than the majority of individuals, but there are intermediate gradations.

Collonia radiata n. s.

Plate 19, figures 6, 7, 8.

Pliocene marl of the Caloosahatchie; a single specimen collected by W. H. Dall.

Shell small, the (immature) type of about three whorls; the nucleus small and smooth, the second whorl radiately ribbed above, and the remainder of the spire smooth except for fine spiral grooving only visible under a glass; periphery with a strong keel against which the suture is laid; base strongly radiately ribbed; umbilicus small, with prominent rounded overhanging rib as its boundary; aperture (immature) rounded, with the edge modified by the sculpture. Alt. 1.2; max. diam. 2.0 mm.

This extremely elegant little shell is immature, but seems to have assumed most of its adult characteristics except around the aperture. It cannot be mistaken for any other species, owing to its marked peculiarities.

Collonia chipolana n. s.

Older Miocene of the Chipola beds, Calhoun County, Florida, Burns.

Shell small, resembling a young specimen of *C. elegantula*, but with much finer sculpture, rounder whorls, no tabulation at the shoulder, a less prominent projection where the umbilical rib impinges on the aperture, and a decidedly thinner and smaller shell. There are about four whorls, which do not complete the growth, as the unique specimen is immature; they are rounded, with a distinct suture and finely spirally striated; the aperture resembles in a general way that of a young *C. elegantula*. Alt. of shell 2.2; max. diam. 2.0 mm.

The shell, though immature, is an unmistakable *Collonia*, and I have described it, lest it should be lost sight of, being the only representative of the group in the Chipola Miocene. I prefer to wait for the reception of an adult specimen before figuring the species.

Collonia claibornensis n. s.

Plate 22, figure 26.

Eocene of the Claiborne sands horizon, at Claiborne, Ala., Burns; a single example.

Shell small, turbiniform, spirally sculptured, of four whorls; upper whorls with small, alternated spirals, of which one larger than the rest partly tabulates the whorls in front of the suture; periphery rounded, also the base, both evenly spirally threaded, the interspaces obliquely cut by regularly spaced incremental lines; umbilicus closed, umbilical rib wide, strong, not very elevated; marginal sulcus at the pillar distinct, aperture rounded, margin thickened and slightly expanded. Alt. 3.5; max. diam. 3.25 mm.

The specimen had been broken before reaching maturity, which has somewhat affected the growth of the umbilical rib. The umbilicus itself is closed, but the form and character of the shell on the whole are so strikingly similar to the younger stages of *Collonia elegantula* that I have little if any doubt as to its generic place.

FAMILY TROCHIDÆ.

Genus **CHLOROSTOMA** Swainson.

Subgenus **Omphalius** Philippi.

Chlorostoma Swainson, Malac., p. 350, 1840 (in part).
Monilea and *Liotrochus* sp. Conrad, Proc. Acad. Nat. Sci. 1862, p. 569.
Monodonta sp. Tuomey and Holmes, Pleioc. Fos. S. C., p. 116, 1856.
Turbo sp. Heilprin, Trans. Wagner Inst. i. p. 113, 1887.

Though some of the American species of this group approach *Monilea* in appearance, there can be little doubt that these merely represent in *Chlorostoma* the result of the same dynamic influences which in the exotic *Gibbula* have resulted in the evolution of *Monilea*.

Chlorostoma (Omphalius) exoletum Conrad sp.

Plate 17, figures 4, 4 a.

Monodonta exoluta (*sic*) Conr., Proc. Acad. Nat. Sci. i. p. 309, 1843; *Monilia* do. Conr., Proc. for 1862, p. 569, 1863 (error typogr. for *exoleta*).
Turbo heliciformis Heilprin, Trans. Wagner Inst. i. p. 113, pl. 16, fig. 55, 1887.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Willcox and Burns; and the equivalent stratum at Alum Bluff, Chattahoochee River, W. Fla., Burns (var. *limatum*); Newer Miocene or Chesapeake beds on the Cape Fear River, at Mrs. Purdy's marl-beds, Johnson; at the Natural Well, Duplin Co., N. Car., Burns; and at Shell Branch, near Darlington, S. Car., Burns.

This species, somewhat variable within certain limits, does not appear in the Caloosahatchie Pliocene nor in the recent fauna. It is rather uniformly spirally threaded with articulated light and dark color-markings on the threads. Some specimens show a fine, sharp secondary striation, but this is not a constant character. It is not impossible that *Monodonta Kiahwahensis* of Tuomey and Holmes is merely a rather elevated specimen of this species, but I have had no opportunity to compare with the type.

Chlorostoma (exoletum var. ?) **limatum** Dall.

Older Miocene of the lower bed, at Alum Bluff, and one mile below Bailey's Ferry on the Chipola River, Florida.

This, which may prove with more material to be a distinct species, differs from *C. exoletum* by its nearly smooth surface, and, in the young, by having one or two keels near the periphery, which are the more prominent from the general smoothness of the shell; and a somewhat smaller umbilicus bounded by a strongly annulated or transversely wrinkled rib; the shell is on the whole more depressed than *exoletum*, but has similar, though fewer, lines, articulated with dark and light color. The most nearly adult specimen measures 7 mm. high by about 9.5 mm. in greatest diameter. It is a variation from *exoletum* in the direction of *C. fasciatum* Born.

Chlorostoma (Omphalius) fasciatum Born.

Trochus fasciatus Born, Mus. Cæs. Vind. p. 331, pl. 12, figs. 3, 4.

Pliocene of the Caloosahatchie beds, Willcox and Dall; recent in the Antilles, the Florida Keys, and the west coast of the Gulf of Mexico as far north as Texas.

This elegant shell appears well developed, and with its color-pattern almost perfectly preserved, in the Caloosahatchie Pliocene. A feature not commonly noted in the descriptions, yet frequently conspicuous in the young, especially when fossil, is the deep grooving parallel with the umbilical ribs. Something of this sort is occasionally present in the young of all the species of *Omphalius*, though the grooving varies a good deal in intensity, and may be entirely absent. When present in force, it would be just the thing to entrap some inexperienced student into the creation of a " new genus."

Genus **GIBBULA** Risso.

Gibbula americana n. s.

Plate 22, figure 32.

Chesapeake Miocene of Duplin County, North Carolina, Burns.

Shell small, turbinate, of five whorls; nucleus small, smooth; whorls sculptured spirally by (on the last whorl about a dozen) larger primary and smaller intercalary rounded threads, and by numerous regularly-spaced, rather close-set, elevated incremental lines, most conspicuous in the interspaces; one or two of the primaries near the periphery are slightly larger than the rest, otherwise the whorls are evenly rounded; suture distinct; umbilicus small, deep, vertically striated; aperture rounded, outer lip simple; body with a thin callus, pillar slightly thickened. Alt. 4.5; max. diam. 4.6 mm.

This neat little shell has the characteristic aspect of *Gibbula*, being more porcellanous than pearly, with faint indications of flammular color-markings on the spire. It is difficult in a figure to express the distinction between this and a *Cyclostrema* or small *Margarita*, as it is, after all, largely a matter of texture. If I am correct in my identification of the genus, this is the first record of its occurrence, recent or fossil, on our Atlantic coast, though there are several species on the Pacific, and the group is characteristic of the Mediterranean and East Atlantic region. I have therefore selected the name *americana* to designate the species.

Genus **CALLIOSTOMA** Swainson.

Section *Calliostoma* s. s.

Umbilical region of the shell imperforate.

There are quite a number of species of this genus in our Mio-Pliocene strata, which will no doubt be considerably added to with more thorough exploration. The range of variation in the Miocene species appears to be much larger than is commonly the case with recent species. This feature is so marked as to render the specific limits of several of the more common forms somewhat doubtful. The species here enumerated are discriminated according to the material in hand, and it is wholly possible that a larger amount of material might show the number of constant, or reasonably constant, forms to be larger than that here adopted; or some here admitted will possibly sink to varietal rank. Quite a number of Conrad's species have never been figured, and his types cannot in most cases be certainly identified, though a high degree of probability attaches to most of the identifications, which were made by the aid of the collection of the Academy of Natural Sciences, in which the types, so far as they have been preserved, must be sought. Those of H. C. Lea's paper on the Virginia Miocene are well preserved, but many of those named by Conrad, being neither numbered nor mounted on tablets, have been so much handled that a shade of doubt will rest on the authenticity of most of them forever. In order to clear up the subject a little, I have been obliged to review all the species, and have figured several of the old ones in such a way as to render them identifiable, which they can hardly be said to have been hitherto. Conrad's figures are often extremely bad, and his diagnoses unfortunately brief, so that much study is necessary among the nearly allied forms to determine which, if any, has the right to bear the name. It cannot be said that the present determinations are infallible, but the writer has used his best efforts to reach the truth.

Calliostoma philanthropus Conrad.

Plate 18, figure 9 a.

Trochus philanthropus Conr., Journ. Acad. Nat. Sci. vii. p. 137, 1834; Tuomey and Holmes, Pleioc. Fos. S. C., p. 117, pl. xxvi. fig. 2; Emmons, Geol. Rep. N. C., p. 272, fig. 167.

Zizyphinus philanthropus Conr., Proc. Acad. Nat. Sci. 1862, p. 569; Meek, Checklist Miocene Fos. U. S., p. 15, 1864.

Miocene of Calvert Cliffs, Calvert Co., and Jones's Wharf, St. Mary's Co., Md., Burns; of James River, Va., Conrad; Petersburg, Va., Lea; near Yorktown at various localities, Harris and Darton; Cape Fear River, at Mrs. Guion's marl-bed, Johnson; Darlington, S. C., Tuomey and Holmes.

A specimen of this species and one of *T. Mitchelli* Conr. were found in the same tray at the Academy, with a label in Conrad's handwriting bearing one name on one side and the other name on the other side of one and the same slip of paper. As the specimens agree with the traditionary identification of the two species, there can be little question as to their authenticity.

This is, perhaps, the most common species of the Virginia Miocene, and grows to the size of 19 to 20 mm. high and wide. The most usual form is characterized by, on the early whorls, three subequal beaded spirals, which have much wider, smooth interspaces, in which a single plain smaller thread gradually appears. The periphery is squared, or even channelled, the posterior angle being formed by a strong, plain rib, the basal angle by one more feeble, and there may or may not be several finer threads in the channel. In old specimens the channel is obsolete, the periphery rounded and finely spirally threaded. The base is furnished with half a dozen wide, flattish spirals outside of the umbilical region, beyond which the threads are smaller. The umbilical region is slightly excavated, but imperforate. The suture is appressed, and runs on the basal keel of the periphery. The upper part of the whorls is subconcave or slightly impressed. The beaded spirals sometimes lose their pustules, that thread which is next the suture behind retaining them longest. Young specimens often have the middle of the base smooth, flat, and destitute of spirals.

Calliostoma philanthropus var. **eliminatum** Dall.

Plate 18, figure 9.

Newer Miocene of the Cape Fear River, Johnson, from Mrs. Guion's marl-bed.

Shell depressed conic, of about six whorls; nucleus lost in the specimen; upper surface of the whorls marked by a single beaded raised line near the posterior suture, and by another not quite so near the anterior suture; on the latter the beading becomes more or less obsolete on the last whorl; between the two beaded lines the surface is concave and obscurely spirally striate; sutures distinct; base somewhat flattened, not umbilicate, but with two wavy or beaded strong spiral bands about the umbilical region; outside of these are four others successively smaller and more adjacent, beyond which the surface is obscurely striate to the periphery; between the primary lines first mentioned the interspaces show fine intercalary threads, two to four in each; umbilical region depressed, callous; pillar short, concavely arched, smooth; outer lip broken away in the type. Alt. of shell 13; diameter probably about 15 mm. when perfect.

This variety differs from the type by the elimination of much of the spiral sculpture, by the beading of the posterior peripheral keel and of several of the spirals near the umbilical region, and the absence of the peripheral channel. The intercalary threads are also much finer and more numerous and the shell more depressed.

Calliostoma philanthropus var. **basicum** Dall.

Chesapeake Miocene of Petersburg, Va., H. C. Lea.

This variety has the beading very prominent on all the spirals of the upper surface, the posterior peripheral keel very strong and beaded, the spirals of the base, to the number of six, very strong, simple, with excavated interspaces, sometimes with an intercalary fine thread. This form leads directly toward *C. Mitchelli* Conrad, which, in its typical features is markedly different from the typical *philanthropus*. In fact, it is almost exactly intermediate between the two forms.

Calliostoma (**philanthropus** var. ?) **Conradianum** Dall.

Plate 22, figure 34.

Chesapeake Miocene (of Petersburg, Va. ?) collection of the Academy of Natural Sciences at Philadelphia.

Shell large, turbinate, with one or two smooth nuclear and eight or more subsequent sculptured whorls; shell above the periphery slightly excavated or flattish, the periphery marked by a stout sculptured prominent spiral band in the earlier whorls, becoming obsolete on the last whorl and a half; suture distinct, wound some distance below the periphery; base moderately rounded, as is the periphery of the last whorl; spiral sculpture of (on the early whorls about three) beaded spiral lines, that at the periphery straplike, with the beading squarish, those above narrow and with the beads more rounded; these increase with the growth of the shell by intercalation, the intercalary threads appearing first as a simple elevated line, then wavy and at last beaded; between the periphery and the suture in front are one or two more smaller, rippled lines, which in the last whorl or two become divided into numerous subequal, fine, somewhat wavy, elevated lines, merging with those into which the peripheral band becomes similarly modified, so that the finest and least prominent spiral sculpture of the shell on the last whorl or two is found on the periphery; base in the adult with similar wavy, somewhat alternated spirals, the primaries gradually increasing in size toward the axis; transverse sculpture of flexuous incremental lines, rather feeble, and most noticeable on the base; aperture subquadrate, oblique, with the outer lip thin-edged and nearly smooth within, the pillar simple, smooth, concave, with a moderate fasciole on the base behind it, but no pit or umbilicus; the body with a thin wash of callus.

Alt. of adult shell 44; max. diam. of base 40; min. diam. 35 mm.; alt. of the last whorl 27 mm.

The early portion of this splendid shell recalls in its sculpture the variety *basicum*, with which it almost exactly agrees, but the base, even at that age, is destitute of the six strong subequal spirals which characterize that form, and the adult shell is many times larger than any recorded specimen of either the typical *philanthropus* or any of its varieties. Yet the similarity of the early whorls is so striking that I cannot feel confident that the present form is distinct. It may be that most of the specimens of *philanthropus* hitherto collected were shallow-water shells, and that the species in deeper water, as in the case of several recent species, attained a much larger size than their average would indicate. The specimens from which this description was drawn up were lent to the writer by permission of the Academy, and bear no label of exact locality, or name of collector. They are merely indicated as belonging to the "Atlantic Miocene" of the United States. The matrix is quite similar to that of specimens from Petersburg, Va., and they may have been collected there. The only species of our Eastern fauna at all comparable with this fine shell is the *C. Sayanum* Dall, which is profoundly umbilicated and relatively more depressed.

Calliostoma Mitchelli Conrad.

Trochus Mitchelli Conr., Journ. Acad. Nat. Sci. Phila. vii. p. 137, 1834.
Zizyphinus Mitchelli Conr., Proc. Acad. Nat. Sci. Phila. 1862, p. 569, 1863.

Chesapeake Miocene of Yorktown, Virginia, and Duplin County, North Carolina.

This fine species is closely related to *C. Ruffinii* Conrad, but differs by its strong spirals, which are sharply annulate rather than beaded, the periphery being marked by a pair of especially strong ones, the anterior of which becomes buried in the suture. Although described more than half a century ago, I believe this handsome shell has never been figured.

Calliostoma Ruffinii H. C. Lea.

Trochus Ruffinii Lea, Trans. Am. Phil. Soc., 2d Ser. ix. p. 40 (reprint), pl. 37, fig. 86, 1845.
Trochus armillus Lea, *op. cit.* p. 38, pl. 37, fig. 81, 1845.
Trochus torquatus Lea, *op. cit.* p. 40, pl. 37, fig. 84, *fide* O. Meyer, Proc. Am. Phil. Soc. xxv. p. 137, 1888.
Zizyphinus Ruffinii Conr., Proc. Acad. Nat Sci. 1862, p. 569.

Chesapeake Miocene of Petersburg, Va., Lea; of Yorktown, G. D. Harris; Newer Miocene of Cape Fear River, N. C., at Mrs. Purdy's marl-bed, Johnson; Pliocene of the Waccamaw beds, Waccamaw River, S. Carolina (var.), Johnson.

Several of the Trochids described by H. C. Lea in the paper referred to are unrecognizable tips of larger species, or specimens so young as to be uncharacteristic; as the nuclear portions of different allied species are frequently almost identical in sculpture. But from the broken type of his *T. Ruffinii* the form may be identified. *T. armillus* Lea may be the young of *philanthropus*, *Mitchelli* or *Ruffinii*, and the same is true of *torquatus*, which has been identified with *Ruffinii* by Meyer. It is probably as well to refer them both to *Ruffinii*, which is the only one of the three which can be positively diagnosed.

The type-specimen of *T. Ruffinii* shows three spiral rows of prominent beads, each with a fine simple thread in front of it. The periphery is subangular as in *philanthropus*, the posterior keel is beaded with squarish imbricated swellings, in front of it are two strong plain spirals, with one very fine simple thread between them in a rather wider, sub-channelled interspace. The typical characters are the double posterior keel, one thread imbricated, the other plain, and the sharpness of the beads or pustular sculpture. Other Miocene specimens show variations leading toward *Mitchelli* and *philanthropus*, but perhaps not quite bridging the gap. The Pliocene specimen from the Waccamaw is young, with slender intercalary threads in all the basal interspaces and all, even the intercalary threads on the spire, sharply beaded. With greater maturity these pronounced features would probably have become less conspicuous.

Calliostoma metrium n. s.

Plate 22, figure 27.

Older Miocene of the Chipola beds near Bailey's Ferry, on the Chipola River, Calhoun Co., Florida, Burns, and of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, Dall.

Shell large, extremely thin, conical, with the surface between the sutures flat or slightly concave, with seven or more whorls exclusive of the nucleus; spiral sculpture of subequal, close-set, flattened threads covering nearly all of the whorl, with narrower interspaces in which, on the later whorls, runs generally a much smaller, simple, elevated line; a few of the spirals on either side the suture are adjacent to one another, the peripheral spiral on which the suture is wound is simple, the others are obliquely articulated by impressed incremental lines; the suture is closely appressed and inconspicuous; the base appears to be imperforate, with the primary spirals becoming stronger toward the axis; pillar stout, with a moderate fasciole behind it; aperture not visible in the specimen. Alt. of shell, without the nucleus, 18; max. diam. of last whorl 20; min. diam 18 mm.

A single specimen of this well-marked species was obtained by Mr. Burns, but the shell is so thin that it is not practicable to remove the indurated matrix from the aperture. The species is not likely to be confounded with any other of our coast, either recent or fossil. A fragment obtained at Ballast Point differs only in having the suture slightly more impressed.

Calliostoma Willcoxianum n. s.

Plate 18, figure 1.

Miocene of Duplin Co., N. Car., Burns; Pliocene of the Caloosahatchie beds, Dall and Willcox; and of Shell Creek, Fla., Willcox.

Shell with nine whorls, the nucleus small, smooth, inflated, of nearly two whorls, the remainder of the shell closely spirally sculptured; the form is that of *C. philanthropus*, of which this species is without doubt the Pliocene representative, and the shell is therefore best described differentially; the sculpture of *Willcoxianum* is of stronger, more close-set threads, with more pronounced beading, narrower interspaces and less angular periphery. The spirals on the base are stronger, stouter and more rounded, those near the umbilical region are obscurely beaded, with sharply cut interspaces. The excavation of the columellar callus is more pronounced than in *philanthropus*, and there is sometimes a rounded pit, though no perforation. The very young are very depressed, have a minute but deep umbilicus, with two strongly beaded projecting spirals next to it, from which the base slopes away to the periphery, with sharp, plain spiral sculpture. In *philanthropus* of the same size the base is flatter, imperforate, and with a smooth, flat area between the sculpture around the umbilicus, and a single sharp thread near the periphery. The difference between the two forms is much more marked in these young shells than in the older ones. The adult measures 15 mm. high and 16 mm. in greatest width.

The changes which we observe between the Miocene and Pliocene species of this type—*i. e.*, stouter and closer sculpture and more rounded periphery—continue in the same line into the recent fauna, where the recent representative, *C. euglyptum* A. Adams, doubtless the descendant of *C. philanthropus* and *Willcoxianum*, is more rounded than the latter, and with closer and still more beaded, though less prominent, sculpture, while its variability is much less than in the Miocene shells. The Miocene specimen of *C. Willcoxianum* obtained by Mr. Burns is a very young shell, but appears to agree with the Pliocene specimens.

Calliostoma bellum Conrad.

Trochus bellus Conrad, Journ. Acad. Nat. Sci. vii. p. 137, 1834.
Zizyphinus bellus Conrad, Proc. Acad. Nat. Sci. 1862, p. 569.

Chesapeake Miocene of James River, Va., of Duplin Co., N. Car., and of Darlington, South Carolina, Burns and Harris.

This shell resembles a small *C. euglyptum*, with sparser spirals and peculiarly prominent and universal prickly beading, especially strong on the base. It is, perhaps, the precursor of the next species.

Calliostoma roseolum var. permagnum Dall.

Calliostoma roseolum Dall, Rep. Blake Gastr., p. 366, pl. xxiv. figs. 6, 6 a; Bull. Mus. Comp. Zool. ix. p. 45, 1881.

Typical form in warm water from North Carolina to Yucatan in 15 to 20 fathoms. Variety *permagnum*, Caloosahatchie Pliocene, W. H. Dall.

The adult specimen from the Caloosahatchie agrees in every particular with the recent specimens, except that it measures 19.5 mm. in height as against less than half as much for the largest specimen of the recent shell which has yet come to hand. As the recent form may grow larger than the specimens yet received, and mere size does not seem to be a very weighty specific character, I prefer to apply the same name to both.

Calliostoma virginicum Conrad.

Plate 18, figure 2.

Zizyphinus virginicus Conrad, Geol. Rep. N. Carolina, 1875, Appendix, p. 22, pl. 4, fig. 4.

Chesapeake Miocene of Suffolk, Va., Conrad; and near Yorktown, Va., Messrs. Harris and Darton, of the U. S. Geological Survey; Cape Fear River marls, Johnson.

This fine species has been inadequately described and figured by Conrad, and it was thought best to figure one of the Yorktown specimens, in order that the species should be recognizable.

The shell measures 13.0 mm. in height and slightly more in maximum diameter. It has a channelled periphery with two strong, equal keels, rounded and finely striated. The suture runs on the anterior keel, and has in front of it (separated by a smooth space about as wide as the peripheral channel) a single strong thread. This combination strongly accentuates the suture. The space in front of the strong thread and extending to the periphery is constricted or excavated, and sculptured with very fine, close, simple and subequal spirals. The base has one or two strong threads about the umbilical region, then finer ones extending to the periphery. There is a shallow groove behind the pillar, but no perforation. The apex is rather blunt, the nucleus small and smooth, and there are five or six turns. The specimens vary in proportional height, some being less elevated, but the general character of the sculpture is very uniform.

This species is really related to *Mitchelli* and *philanthropus*. The suppression of the beading, the magnification of the sutural and peripheral keels, and the presence of many fine, even spirals in place of fewer unequal ones, are the modifications which would bring the forms together, and such modifications are not uncommon in the group, as we have already seen in the case of the varieties of *C. philanthropus*. The following variety gives point to these observations:

Calliostoma (**virginicum** var.?) **aluminium** Dall.

Chesapeake Miocene of the upper bed at Alum Bluff, Chattahoochee River, Florida, Burns.

A single specimen was obtained by Mr. Burns which recalls *C. virginicum*, but differs from it in the following particulars: The sutural rib is strong and strongly rippled or beaded, as is the posterior peripheral keel; between them, instead of numerous even, fine spirals, there are three or four larger, obscurely waved primaries, while the remainder are small and fine; on the base there is a narrow, deep groove behind the pillar, outside of which are six or seven strong, flattened spirals with the interspaces finely spirally grooved. The base is rather flatter than in the majority of specimens of *virginicum*, and the spire more straight-sided in its declivity. There are about six whorls, the last of which is defective. The shell is about 11 mm. high, with proportions similar to *C. virginicum*.

This shell may prove to be a distinct species, in which case it may keep as specific the varietal name, but whether a species or a variety, it undoubtedly forms an intermediate phase between *C. virginicum* and *C. philanthropus*.

Calliostoma grammaticum n. s.

Plate 18, figure 2 a.

Older Miocene of the lower bed at Alum Bluff, Chattahoochee River, and of the Chipola beds on the Chipola River, Florida, Burns.

Shell with seven whorls, the nucleus small and smooth, the remaining whorls strongly spirally sculptured; the periphery is smooth and rounded, overhanging like a broad rib the suture, which is closely appressed below it; between the suture and the peripheral rib are three to five strong, smooth spirals, disposed in scalar fashion like steps up the spire, with sharp-cut interspaces, the number increasing by intercalation, and the area they cover slightly impressed; there is no finer sculpture on the spire; the base is gently rounded, flattish, smooth except for wavy incremental lines and two or three strong spirals close to the umbilical region, which is bounded by a swollen rib and imperforate; pillar arched, a blunt tooth at the base; aperture ovate-quadrangular, smooth inside; the young have the base flatter, with obscure, impressed spiral lines and a single feeble thread near the periphery. Alt. and diameter 13.5 mm.

This fine species, with its uniform smooth clean-cut spirals, is very distinctive and unlike any other in the American Tertiary.

Calliostoma exile n. s.

Chipola Miocene of the lower bed at Alum Bluff, Chattahoochee River, Florida, Burns.

Shell acute-conical, with more than four whorls, the apex of the specimen decollated; whorls smooth except for lines of growth and two or three fine, incised spiral lines just above the periphery; periphery prominent, rounded, slightly overhanging the suture; base smooth or sparsely spirally striated, imperforate, impressed, so that the periphery when the shell is held base upward is elevated and forms a narrow, raised margin around the impressed area it encloses; aperture subquadrate, wider than high. Alt. of shell with the last whorl deficient about 7.0; max. diam. 5.5 mm.

Though represented by a very imperfect, single specimen, this shell is undoubtedly different from either fossil or recent forms from our coast yet known, and recalls the European *C. conulus*. I have delayed figuring it in the hope of securing a better specimen, but the characters are so distinct that it cannot be mistaken for any other American species.

Calliostoma eboreum Wagner.

Trochus eboreus Wagner, Journ. Acad Nat. Sci. Phila. viii. p. 52, pl. 1, fig. 5. 1838.

? *Monilia* (*Leiotrochus*) *eborea* Conrad, Proc. Acad. Nat. Sci. 1863, p. 569; Meek, Miocene Checklist, p. 15, 1864.

Miocene of the Patuxent River, Maryland (Wagner), and of Shiloh and Jericho, New Jersey, Burns; also near Church Hill, Md., Harris.

This species is a typical *Calliostoma*, with a rather angular periphery which forms a line over the suture below it, a polished surface, mostly smooth, with a few fine but distinct, elevated spiral threads, rather irregularly disposed and sometimes absent. The base is generally smooth, flattish, imperforate, with the usual arched pillar ending in an obscure projection (common to the genus) and a few spiral threads about the umbilical region. Old specimens have the last whorl less angular at the periphery, the base rounded and the aperture less quadrate than in smaller specimens. The threading is irregular and occasionally profuse or entirely absent.

The type of Conrad's genus which he called *Leiotrochus* (Proc. Acad. Nat. Sci. 1862, p. 288) is *L. distans* Conrad, a species described as follows: "Trochiform; volutions 4; suture subcanaliculate near the apex; revolving lines, a few distant, distinct, impressed, the others very fine; periphery rounded; base convex-depressed, with six distant, impressed revolving lines and very fine intermediate lines; umbilicus narrow, profound; subcarinated at base. Locality, Calvert Co., Md.?" The shell appears never to have been figured under this name, nor could the type be found in Philadelphia, but it agrees well with a species which he afterward described and (badly) figured under the names *Zizyphinus punctatus* and *Briani*, and which comes from the locality mentioned. The following year Conrad, in his "Catalogue of the Miocene Shells of the Atlantic Slope," reduces *Leiotrochus* to subgeneric rank, places it under *Monilia* (*sic*) Swainson, and includes with his type *Trochus eboreus* Wagner, *Turbo caperatus* Conr. and *Monodonta* (= *Omphalius*) *kiahwahensis* Tuomey and Holmes. He gives the following diagnosis of the subgenus *Leiotrochus*: "Polished, entire, without umbilicus; base of columella with two denticles." On the next page (570), under *Carinorbis* (= *Fossarus*), we find the same species, *distans*, with the same references as before! To add to the confusion, about the date of the above catalogue a set of Tertiary fossils named by Conrad was presented by Haldeman to the Smithsonian Institution which included several specimens of a shell labelled "*Monilia eborea* (Wag.) Conr., Patuxent, Md.," but belonging to an entirely different species from Wagner's shell, and really Eocene.

It is probable that even Conrad never perpetrated more numerous blunders in so few lines of text as in the present case. The diagnosis, judged by the species grouped under it, is absurd. None of them has two denticles on the columella; *Omphalius kiahwahensis* is not polished and has a wide umbilicus; *Leiotrochus distans*, in Conrad's own words, has it "narrow, profound." Nothing is known of the umbilical characters of the unpolished non-denticulate *Turbo caperatus*, and *Monilea eborea* Conr. (*non* Wagner) has a deep pit, though not a perforation or a denticle. *Trochus eboreus* Wagner has no umbilicus. None of the species belong to the genus *Monilea* Swainson, while Conrad's own type is placed by him both in *Monilea* and *Fossarus*.

Notwithstanding all this, if we eliminate the true *Trochus eboreus* Wagner (*non* Conrad), there is a superficial similarity between the shells Conrad grouped together; they are without strong sculpture, are turbinate rather than trochiform, mostly have some obscure callosity on the pillar, and in general outline have a certain similarity to the shell figured by H. and A. Adams as an example of *Monilea*. However, the group cannot be considered as a natural one, and must stand or fall by its original sole species and type, *L. distans*. If I am correct in identifying this (in the absence of the type and without any figure) with the shell subsequently named *Briani* by Conrad—that is, simply a small species of *Calliostoma* of the section *Eutrochus* Adams—while the name *Leiotrochus* has a few months' priority over *Eutrochus*, the doubts which hang about it seem to the writer to make it inadvisable to adopt the former as a substitute for the latter. If others take the same view, the name *Leiotrochus* will simply fall into the synonymy of *Calliostoma*.

Calliostoma (**eboreum** Wagner var. ?) **Wagneri** Dall.

Plate 21, figure 3.

Shell small, rather depressed, with a rather large, smooth nucleus and five subsequent whorls; surface of the shell smooth except for lines of growth; whorls at the periphery flattened, with two well-separated keels, the upper the more prominent; the suture in the earlier whorls is applied to the upper keel, but gradually recedes from it and runs about midway between them; immediately in front of the suture the whorl shows a narrow, rounded ridge parallel with the suture; between this ridge and the upper peripheral keel the surface of the whorl is excavated or impressed to an extent varying in different specimens; base smooth, umbilical region with a wrinkled callus, sometimes bounded by one or two spiral grooves, but often without them; pillar short, thick, with an obscure denticle; aperture subquadate, outer lip simple, throat not lirate. Max. diam. of shell 10.0; alt. 8.5 mm.

This interesting shell, obtained by Mr. G. D. Harris, U. S. Geol. Survey, from the older Miocene of Greensboro', Caroline Co., on the "eastern shore" of Maryland, is probably a distinct species, though allied to *eboreum*. It differs from the latter in its more depressed form, doubly carinate periphery, excavated upper surface of the whorls (in most specimens), and absence of spiral striation. However, these early forms are so variable that a connecting series may possibly turn up with further exploration.

Calliostoma aphelium n. s.

Plate 22, figure 29.

Chesapeake Miocene of Calvert Cliffs and Jones's Wharf, Maryland, Burns and Harris.

Shell small, somewhat depressed, with five whorls; suture impressed, not channelled; upper surface of the whorls smooth except for lines of growth and nearly invisible obsolete spiral markings, somewhat flattened; periphery prominent, almost carinated; base slightly rounded, without sculpture; umbilicus represented by a deep imperforate pit; umbilical fasciole strong, callous, irregularly vertically striated; aperture subquadrate, outer lip simple, sharp; inner lip broad, with a callous knob upon it; body with a thin wash of callus. Alt. of shell 7; max. diam. 9 mm.

This simple little shell recalls *C. eboreum* Wagner and *C. Harrisii* Dall, but seems sufficiently distinct from both; *C. nitens* resembles it somewhat, but is more compact, depressed and, relatively, very much more massive.

Calliostoma nitens Lea.

Plate 22, figure 30.

Turbo nitens Lea, Contr. Geol., p. 125, pl. 4, fig. 115, 1833.
Solariorbis nitens Conrad, *Delphinula nitens* De Gregorio.

Eocene of the Claiborne sands, Claiborne, Alabama.

Shell small, solid, depressed, with five whorls, smooth except for lines of growth; surface polished, suture impressed; periphery subangulate; base slightly rounded, with a minute central perforation; umbilical carina simple, rounded, the wall above it excavated; umbilical fasciole feebly marked; aperture oblique, subrotundate, with a moderate callus on the body and a small prominence on the pillar. Alt. 4; max. diam. 6 mm.

This little shell is most likely to be confounded with *Dillwynella naticoides*, from which its heavy nacreous layer, depressed form and perforate umbilicus are sufficient, when observed, to discriminate it. Though usually perforate, it seems to belong here rather than in *Eutrochus*. It seems common at Claiborne.

Calliostoma erosum n. s.

Plate 18, figure 7.

Croatan Pliocene beds of the Neuse River, North Carolina, C. W. Johnson.

Shell elevated-conical, rather acute, with seven and a half whorls, of which two comprise the minute smooth nucleus, two and a half more are reticulately and the rest spirally sculptured; earlier whorls with three or four flat, close-set, rather wide spirals cut by radiating lines so as to be chequered or obsoletely reticulated; as the whorls increase the spirals merge in the general smooth surface, and the grooves which separated them are continued as impressed lines which become quite faint on the last whorl; base with eight or more flat weak spirals, stronger near the pillar; there is no umbilical pit or groove; the periphery is rounded; the suture very distinct, but not channelled; the whorls slightly convex, the aperture ovate-quadrangular. Alt. 10; max. diam. 9 mm.

This is a very simple little shell, easily identified by the microscopic sculpture of the earlier whorls, which, except when examined under a glass, is likely to be unnoticed.

Calliostoma labrosum Conrad.

Trochus labrosus Conrad, Journ. Acad. Nat. Sci. vii. p. 138, 1834.

Zizyphinus labrosus Conr., Proc. Acad. Nat. Sci. 1862, p. 569.

James River, Va., in the Chesapeake Miocene.

This species recalls *T. humilis* Conrad, which is umbilicate, and *C. virginicum*, which is a more elevated shell. In *C. labrosum* the minute one-whorled nucleus is smooth, the next two whorls are furnished with three strong rounded spirals occupying the whole surface between the sutures; these become less prominent and the adult sculpture comprises a channelled periphery, of which the two ribs are rounded and the lower one more prominent, a strong spiral a little in front of the appressed suture, which latter runs just below and is slightly overshadowed by the lower peripheral keel; the top of the later whorls is impressed as in *C. virginicum*, but this channel is smooth, polished and sculptured, usually by distant impressed lines which become more numerous with age; the base is flattish, polished, with two very strong spirals near the pillar, no umbilical pit, numerous fine striæ near the periphery and smoother middle area; the whole shell is low, with a rather pointed apex. Alt. 7; max. diam. 9.5 mm., in a specimen not quite mature.

I have not found any figure of this species, and therefore describe its characters more in detail that others may identify it. The specimen in the National Museum was named by Conrad.

Calliostoma Harrisii n. s.

Plate 18, figure 6.

Chesapeake Miocene of Yorktown and Bellefield, York River, Virginia, collected by Mr. Gilbert D. Harris, of the U. S. Geological Survey.

Shell wide, conical, with the sides of the spire rectilinear and the periphery subangulate, six-whorled; nucleus smooth, small, blunt, of two whorls;

the next whorl or two show unequal spirals, but over most of the shell the sculpture consists chiefly of numerous regular, equal spiral threads with subequal interspaces, there being a single strong thread, separated by a narrow, shallow channel from the suture behind it, running up the spire; the base, slightly convex, is sculptured like the spire, the threads stronger toward the pillar, which is, as usual in the genus, broad, with a narrow recess, not a pit or chink, behind it; aperture subquadrate, the outer lip flexuous above at maturity; the throat is not lirate. Alt. 10; max. diam. of base 12 mm.

This species, named in honor of Mr. G. D. Harris, Assistant Paleontologist U. S. Geol. Survey, is related to *eboreum* and *virginicum*, but seems specifically distinct from any of them. The description of *Trochus lapidosus* by Conrad agrees with the characters of *C. Harrisii* to some extent, but Conrad's species is umbilicated and is stated to be related to *T. humilis*, of which, indeed, *lapidosus* may perhaps prove a synonym.

Section *Eutrochus* A. Adams.

This section is separated from the typical species of *Calliostoma* for convenience, and includes the umbilicated forms. Some species like *C. jujubinum* occasionally bridge the gap, this feature differing in different individuals, and many species have a narrow umbilical chink in the adolescent state which they lose when fully mature.

Calliostoma (Eutrochus) distans Conrad.

Leiotrochus distans Conrad, Proc. Acad. Nat. Sci. for 1862, p. 288, 1863.
Monilia (*Leiotrochus*) *distans* Conrad, *op. cit.* p. 569, 1863.
Carinorbis distans Conrad, *op. cit.* p. 570, 1863.
Zizyphinus punctatus Conrad, Am. Journ. Conch. iii. p. 257, pl. 21, fig. 5, Jan., 1868.
Zizyphinus Briani Conrad, *op. cit.* p. 258, pl. 21, fig. 9, 1868.
Zizyphinus arenosus Conrad, Proc. Acad. Nat. Sci. 1852, p. 569, 1863.

Chesapeake Miocene of Maryland and Virginia, at St. Mary's River (O. N. Bryan coll.), in Charles Co., Md.; near Yorktown, Va., Harris; and from Mrs. Purdy's marl-bed, Cape Fear River, N. C., Johnson (var. *arenosum*).

This species has a sufficiently varied synonymy. A specimen named by Conrad was sent to the Smithsonian Institution labelled *Zizyphinus distans*. Some years later Conrad borrowed the specimen and redescribed it under the name of *punctatus*, a slight corrosion of the shelly matter along the impressed lines having given them a punctate appearance. Another specimen in a normal condition was received by Conrad about the same time from Mr. O. N. Bryan, of Marshall Hall, on the Potomac, and was described as *Z. Briani* (*sic*) in the same paper. In his catalogue of 1863 Conrad gave a name to a figure published by Emmons (Geol. Rep. N. Carolina, p. 272, fig. 168) without any name or diagnosis. He called it *Z. arenosus*, and the receipt of a specimen collected by Mr. C. W. Johnson in North Carolina makes it reasonably certain that this *arenosus* is only a rather depressed variety of *distans*.

The shell appears nearly smooth, with a narrow, deep umbilicus, and the usual blunt, sometimes grooved, tooth at the end of the pillar. Under a glass the spire is seen to be finely spirally threaded, the threads less numerous and more distant in the early whorls. The base is spirally striate, with faint grooves or impressed lines. The suture is obscurely channelled in the early whorls and the periphery is rounded, the whorls slightly so. A well-grown specimen measures 8 mm. high and 10.5 mm. in greatest diameter. It is sometimes a little larger. In addition to the published synonyms, on one of Conrad's manuscript labels in the National Museum collection this species is named *Zizyphinus marylandicus.*

Calliostoma cyclus n. s.

Plate 23, figure 20.

Miocene of the Natural Well, Duplin Co., N. Car., Frank Burns.

Shell small, much depressed, but with a rather prominent apex and four whorls; early whorls with three or four strong, rounded spirals with narrower interspaces, the periphery doubly keeled, but the keels covered up in the closely appressed suture; later the suture falls below the upper keel, and finally follows the lower one; on the later whorls the upper keel is stronger, but both are prominent; the upper surface of the whorl is somewhat excavated between the keel and the suture and is very sharply, almost microscopically spirally striate, the striations crossed by obsolete incremental lines; base flattish, conical, spirally striate like the upper surface; umbilicus narrow, deep, funicular; umbilical rib formed of two close-set, stout spirals surrounded by a sharp groove; aperture subquadrate, oblique, wider than high, pillar simple, straight, thickened toward the basal angle. Alt. 3.5; max. diam. 5.2 mm.

This strongly-marked little shell is probably not fully adult, but its characters cannot be reconciled with the young of any other species now known. The nearest form is *C. armillatum*, which has a moniliferous suture, the upper surface of the whorls rounded or convex, the umbilical ribs conspicuously beaded, and the spiral striation coarser, especially on the base. The adult *armillatum* is not keeled at the periphery, the young sometimes are, but the keel is usually single, and when double not separated by a broad, distinct, deep groove, as in the present form.

Two specimens were obtained by Mr. Burns, the larger of which has served as a basis for the above description.

Calliostoma (Eutrochus) jujubinum Gmelin.

C. jujubinum (Gmel.) Dall, Rep. on Blake Gastr., p. 369, 1889.

Pliocene of the Caloosahatchie and Shell Creek, Fla., Dall and Willcox; recent on the southeastern coast of the United States from Cape Hatteras southward, and throughout the Antilles, in moderate depths.

Both the typical form and the variety *tampaënsis* Conrad appear in the Caloosahatchie beds, but none of the specimens of the typical kind, though apparently adult, are as large as Antillean specimens from the present fauna.

Calliostoma (Eutrochus) armillatum T. & H.

Trochus armillatus Tuomey and Holmes, Pleioc. Fos. S. Carolina, p. 118, pl. 26, fig. 3, 1856.

Zizyphinus armillatus Conr., Cat. Mioc. Sh., Proc. Acad. Nat. Sci. 1862, p. 569, 1863.

"Waccamaw District," S. Car., Tuomey and Holmes; Chesapeake Miocene of Duplin Co. N. Car., Burns; Miocene marl of Cape Fear River, at Mrs. Guion's marl-bed, Johnson.

This pretty little species is well distinguished by its depressed form, wide umbilicus, and single, strong, usually beaded spiral thread near the suture, the other threads on the spire being smaller and plain.

Calliostoma (Eutrochus) limulum n. s.

Plate 18, figure 7 a.

Pliocene of the Caloosahatchie and Shell Creek, Fla.

Shell small, conical, with six somewhat rounded whorls and a rather acute tip, spirally sculptured; nucleus very minute, smooth, remainder of the shell with from four to six subequal, strong, very closely beaded threads, increasing by intercalation, the new threads beginning as extremely fine, simple elevated lines, and gradually becoming beaded, whence at certain stages of growth the spirals have an alternated appearance; there is a single strong or two smaller plain peripheral threads without beading, the threads of the rather convex rounded base are like those of the spire; umbilicus small, deep, bordered by a single stout thread; pillar as usual, aperture rounded-quadrate, the outer lip crenulated at the edge by the sculpture; suture distinct; periphery rounded. Alt. 6; max. diam. of base 6 mm.

This modest little shell is quite uniform in its characters, varying slightly in the size of the umbilicus and the flatness of the spire and base, as *jujubinum* does. From the young of *jujubinum* it is easily distinguished by its smaller umbilicus, relative elevation, and mature aspect.

Calliostoma (Eutrochus) ceramicum n. s.

Plate 18, figure 10.

Older Miocene of the Chipola epoch at Ten-Mile Creek, near Bailey's Ferry, Chipola River, N. W. Florida, F. Burns, U. S. Geol. Survey.

Shell elevated-conic, strongly spirally sculptured with one small smooth nuclear and eight subsequent whorls; spiral sculpture of four strong, squarish, revolving ribs, with somewhat narrower channelled interspaces, crossed by numerous deeply-impressed, evenly-spaced, oblique lines, in harmony with the incremental lines, which produce an effect on the ribs between the intersections analogous to that of tiles on a roof; base with five or six strong spirals of the same sort and two or three smaller ones around the umbilicus; periphery with a single broad smooth spiral, not intersected by the transverse sculpture, and on which the suture is closely laid; umbilicus small, deep, subcylindrical, its marginating riblets forming a projection at the aperture; whorls and base slightly rounded, periphery moderately so; surface polished; aperture rounded-quadrate. Alt. of shell 15; max. diam. of base 14 mm.

The characters of this fine shell are very distinctive, and it can readily be distinguished from any other of our Tertiary species.

Calliostoma (Eutrochus) humilis Conrad.

Trochus humilis Conr., Journ. Acad. Nat. Sci. vi. p. 219, pl. ix. fig. 5, 1830.
Zizyphinus humilis Conr., Cat. Mioc. Fos., Proc. Acad. Nat. Sci. for 1862, p. 569, 1863.
Trochus conus H. C. Lea, Trans. Am. Phil. Soc. ix. p. 39, pl. 37, fig. 82, 1845 (young specimen, from type).
Zizyphinus conus Conrad, Cat. Mioc. Fos., p. 569, 1863.
Trochus lens H. C. Lea, *op. cit.* p. 39, pl. 37, fig. 83, 1845 (young).
Zizyphinus lens Conrad, *op. cit.* p. 569, 1863.
Delphinula trochiformis Lea, *op. cit.* p. 36, pl. 36, fig. 73, 1845; *fide* Meyer, Proc. Am. Phil. Soc. xxv. p. 137, 1888.
Trochus reclusus Conrad, Journ. Acad. Nat. Sci. vi. p. 219, pl. 9, fig. 6, 1830 (probably).
Zizyphinus reclusus Conrad, Cat. Mioc. Fos., p. 569, 1863.

Chesapeake Miocene of St. Mary's River, Maryland (Conrad), and Petersburg, Va. (Lea).

This species, of which the extremely young and broken tips furnished Lea with several of his supposed species, verges toward *Omphalius* in its general aspect, but does not attain the keel bordering the umbilical callus. I was unable to find in the Academy's collection any specimen under the name of *T. reclusus* Conr. not referable to this species, and Conrad's description and figure are so inadequate as to render its distinctness a matter of grave doubt.

Among the other species of *Trochus* in the earlier literature of our Tertiaries not above referred to, *T. rusticus* H. C. Lea is a very young, fragmentary *Omphalius*; *T. aratus* Lea is an unrecognizable apical fragment; *T. gemma* Tuomey and Holmes is with little doubt the same as *Liotia tricarinata* Stearns. I have not seen the type of *T. peralveatus* Conrad, which, however, has been obtained by Burns at Jones's Wharf, Patuxent River, Maryland, and is a very fine and distinct species.

T. nixus Tuomey (*nexus?*), from the Eocene of Wilmington, N. C., is a fine species of *Pleurotomaria*, allied to *P. Adansoniana*. *Trochus alabamiensis* Aldrich, from the Eocene of Matthews' Landing, Alabama, is referable to the genus *Solariella* or *Margarita*.

C. Guppyanum Gabb appears to be a good species. It is from the Costa Rica Pliocene.

In the Older Miocene of Bowden are found *C. decussatum* Gloyne, (MSS. ?), *C. corbis* Dall and *C. sapidum* Dall, the two latter being also known living from deep water in the Antillean region, dredged by the Blake Expedition.

Genus MARGARITA Leach.

This genus extends from the upper Cretaceous to the recent fauna. The shells are somewhat variable in their ornamentation, and may be umbilicated or not, but the umbilical carina, if it exists, is not beaded or tubercular. Shells of this general form, but with the carina annulate or beaded, are distinguished in the recent fauna by marked anatomical differences from *Margarita* proper, and from the genus *Solariella* S. Wood or *Machæroplax* Friele. We are therefore justified in separating the fossils by the purely conchological character.

Meek has proposed a genus *Margaritella* for an upper Cretaceous species with a sharp periphery, scalar umbilicus with uncrenate carina, and the pearly shell of *Margarita*.

Fischer, on the ground that the name had already been used for the pearl oyster, proposes to name the genus *Eumargarita*—a course which I do not think required by the circumstances; but if we must give up the name *Margarita* on this trivial ground, the name of *Margarites* proposed by Leach himself has priority.

Margarita tampaënsis n. s.

Plate 18, figure 5.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Florida, Dall and Burns.

Shell small, thin, of much the form and size of *Margarita helicina*, but with the earlier whorls alternately striate, the striæ becoming finer and at last obsolete on the terminal whorl; suture distinct, whorls rounded above and below; umbilicus small, funicular, aperture expanded, oblique; body with a thin callus. Alt. 7.0; max. diam. 8.0 mm.

The striation on the different specimens varies as in recent species, some having it perceptible though weak on the last whorl, especially below.

Genus SOLARIELLA S. Wood.

Solariella S. Wood, Ann. Mag. N. Hist. ix. p. 531, 1842.
Solariorbis sp. Conrad, Am. Journ. Conch. i p. 30, 1865.
Machæroplax Friele, Arch. Math. Nat. ii. p. 311, 1877.
Solarium sp. Lea, Conrad, De Gregorio, etc.; not of Lamarck.

The typical species of this group are somewhat widely umbilicated, but there are other species which are imperforate, yet by the totality of their characters evidently belong to the same assemblage. We know that in *Margarita* the presence or absence of an umbilicus is hardly a specific character, and in the section *Bathymophila* the young are widely umbilicate and the adult imperforate. So it is evident too much stress must not be laid on this single character.

The group extends through the whole of the Tertiary, beginning in the Mesozoic, and is abundantly represented in the present fauna.

In the Eocene the following species occur: *S. elegans* Lea, with which *stalagmium* Conrad (which was named first, but not recognizably defined or figured before Lea's publication) and *S. perinum* De Gregorio are synonymous. According to Meyer, *Delphinula solarioides* Heilprin is also identical with *elegans*, but I have not examined the type. A variety *modesta*, in which the spiral sculpture is obsolete, has been described by Meyer and Aldrich. This species occurs at Claiborne, and also at Wood's Bluff, Ala., the variety at Wahtubbee, Miss.

Solariella cancellata Lea and Conrad is extremely similar to some of the recent deep-sea species of the Antillean region. It is known from the Claiborne sands, Wood's Bluff, White's marl-bed in Monroe Co., Ala., and at Dry Creek, Jackson, Miss.

Solariella lineata Lea (as *Turbo*), from the Claibornian, has no crenulations around the umbilicus, the margin not being carinate, but rounded; it is obviously a member of this group, nevertheless. *Trochus alabamiensis* Aldrich much resembles a *Margarita*, but has the profuse sculpture and crenulated umbilical keel of *Solariella*. It comes from Prairie Creek and Matthews' Landing, Ala. It is probable that the *Solarium semidecussatum* of Guppy, from the Older Miocene of Haiti, is a *Solariella*, though neither figure nor description is distinctive enough for recognition.

Solariella louisiana n. s.

Plate 23, figure 1.

Eocene of McKay's marl-bed, near Enterprise, Miss., and at Lisbon; in Alabama at Lower Peach Tree Creek, a branch of the Alabama River, Hatchetigbee Bluff, the lower bed at Wood's Bluff, and Butler, Choctaw Co.

Shell small, subconical, with five or six whorls; nucleus small; whorls rounded, with a flattened space in front of the suture, which is distinct and sometimes even slightly channelled; the flattened area is bounded anteriorly by an elevated spiral thread, which, especially on the earlier whorls, is more or less distinctly beaded; beside this the surface is sculptured with spiral grooves separated by about equal interspaces and crossed obliquely by numerous impressed lines, rather evenly spaced and in harmony with the lines of growth; the sculpture throughout is stronger on the upper part of the whorls and on the earlier whorls, on the last whorl it is more or less obsolete in nearly all the specimens; the periphery is evenly rounded; the base slightly flattened; the umbilicus large and funicular, its walls sculptured in both directions, the spirals distinctly beaded; the umbilical carina is crenate, with a narrow sulcus formed by two or three impressed lines, outside of the carina; aperture very oblique, rounded, thin-edged, hardly interrupted by the body-whorl or umbilical carina. Alt. of two specimens, A and B, A 7, B 5.5; max. diam. A 8.5, B 7.0 mm.

This species has been generally confounded with *S. elegans*, which is a less elevated shell with a scalar umbilicus and generally with several elevated, rather distant spirals and more prominent sculpture.

Solariella turritella n. s.

Plate 23, figure 2.

Older Miocene of the Chipola River, one mile below Bailey's Ferry, Calhoun Co., Florida, Burns.

Shell small, conical, with six whorls; nucleus small, inflated, smooth; next two whorls reticulated by about four spiral and numerous transverse elevated threads; subsequent whorls with an elevated thread a little in advance of the suture and two at the periphery, the posterior of these the stronger, beside several rather obscure smaller ones on the base, in addition to which the whole surface is minutely spirally striated; the transverse sculpture consists of numerous minute, narrow riblets, with wider interspaces, directed in harmony with the incremental lines, most elevated just in front of the suture, and by which the posterior primary spiral rib is crenulated, beyond which the riblets are not distinguishable from the lines of growth; the whorl between the suture and the first primary spiral is flattened; in front of the primary it is rounded, the base is swollen; the umbilicus is large and funicular; the umbilical carina strong and crenulated, separated from the base by a well-defined groove; the umbilical walls are coarsely sculptured by two or three strong and several feebler crenulated spirals separated by excavated sulci; the aperture is rounded, with a thin edge, crenulated by the exterior sculpture; color-markings, in the shape of rather distant, small purplish spots, still appear on the primary spirals. Alt. of shell 5.6; max. diam. 6.0 mm.

A single specimen of this pretty and very distinct species was obtained by Mr. Burns.

FAMILY DELPHINULIDÆ.

Genus **LIOTIA** Gray.

Liotia (Gray) Dall, Rep. Blake Gastr., p. 385, 1889.

Liotia (Arene) solariella Heilprin.

Plate 17, figures 1, 1 a.

Delphinula? solariella Heilprin, Trans. Wagn. Inst. i. p. 113, pl. 16, fig. 56, 1887.

Older Miocene of the Tampa Orthaulax bed, at Ballast Point, Tampa Bay, Florida.

The characters of this very pretty little shell are well exhibited by the figures given. It measures 5.8 mm. wide and 5.5 mm. high when adult. The examples seen thus far exhibit little or no variability in regard to sculpture. The specimens are all siliceous pseudomorphs.

Liotia (Arene) coronata n. s.

Plate 17, figures 2, 2 a.

Older Miocene of the Orthaulax bed, Ballast Point, Tampa Bay, Dall.

Shell small, stout, turbiniform, of four whorls; suture running just below the peripheral keel; shell spirally striate, with three moderately prominent plain keels, separated by wider striated interspaces, toward the periphery; summit of the whorls regularly wrinkled at the suture, the wrinkles stronger on the earlier whorls, varying from mere beads to more elongated waves in different specimens, but obsolete on most of the last whorl; base rounded, spirally striate, the umbilicus subcylindrical, small and deep, marginated with a stout, rounded rib; aperture subcircular, margin simple. Alt. of shell 4.0; max. diam. 5.0 mm.

In the figure the sutural wrinkles are not represented with sufficient strength, and are perhaps a little too round in form, though in this the specimens vary a good deal. The species, if represented by a sufficient number of specimens, would probably show a thickened peritreme, but the few yet obtained are apparently not quite mature.

Liotia (Arene?) milium n. s.

Plate 18, figure 4.

Pliocene of the Caloosahatchie, Dall.

Shell minute, spirally sculptured, with one smooth nuclear and two and a half subsequent whorls; spiral sculpture, between the sutures three and on the last whorl between suture and umbilicus eight even, rounded, well-elevated, simple threads separated by equal, channelled interspaces, in which toward the aperture may be a single extremely fine intercalary thread; interstices crossed by rather elevated fine lines of growth not apparent on the ribs; whorls rounded; suture distinct; umbilicus narrow, deep, bordered by a well-marked isolated rib; aperture nearly circular, a little thickened, its outline crenulated by the ribs. Alt. of shell 1.5; max. diam. 1.8 mm.

Liotia (Arene) perarmata n. s.

Plate 19, figures 2, 2 b.

Pliocene of the Caloosahatchie beds.

Shell small, solid, very strongly sculptured, with one small smooth nuclear and three subsequent whorls; spire depressed, apex blunted; surface minutely microscopically shagreened all over with close-set incremental wrinkles; periphery with three very prominent imbricated or beaded keels with deep equal interspaces; between the suture and the upper keel, on the spire, and between the lower keel and the umbilical rib, respectively, are a few smaller, beaded spirals rather variable in character; summit and base of the whorls flattened; umbilicus wide and deep, margined by a strong annulate or beaded rib; within the umbilicus are two high, nearly plain ribs ascending from the aperture; mouth circular, slightly varicose in the adult, rayed about by the ends of the spiral ribs or keels (the figured specimen had not formed its varix). Alt. of adult shell 4.2; max. diam. 5.5 mm.

This species has relations with *L. Bairdii* Dall and *L. variabilis* Dall, of the recent fauna, but is sufficiently distinguished from them by details of sculpture, as well as by its constantly less elevated form. The first specimen found, being unique, was figured, though not quite adult; since then a number of adult specimens have come to hand, on which the diagnosis is based, which will explain some slight discrepancies between it and the figure.

Liotia (Arene) gemma Tuomey and Holmes.

Trochus gemma T. & H , Pleioc. Fos. S. C., p. 118, pl. 26, fig. 4, 1856.
Architectonica tricarinata Stearns, Proc. Bost. Soc. Nat. Hist. for 1872, p. 23, Jan., 1872.
Liotia tricarinata Dall, Rep. Blake Gastr., p. 389, 1889.
Margarita tricarinata Gabb, Geol. Santo Domingo, p. 243, 1873; Journ. Acad. Nat. Sci., 2d Ser., viii. p. 366, pl. 46, f. 64, 1881.

Miocene of Santo Domingo, Gabb, and of the Peedee River, S. Carolina, Tuomey; Pliocene of Costa Rica, Gabb; of the Caloosahatchie beds and Shell Creek, Florida, Dall and Willcox; of the Waccamaw beds of South Carolina, Johnson; and living on the coast from North Carolina to Florida from low-water-mark to 22 fathoms.

There is no doubt of the practical identity of the recent and fossil shells, though the Pliocene specimens are a little larger than the recent ones. Except in the matter of size, they are indistinguishable and vary through the same series of mutations. The names applied by Gabb and Stearns were given independently of each other, Stearns describing the recent shell and Gabb the Antillean fossil. Guppy queries * whether Gabb's shell is not identical with *Cyclostrema bicarinatum* Guppy and *Adeorbis carinata* Gabb, but these species are quite distinct from each other, the latter being an *Episcynia* resembling *V.* (*E.*) *inornata* Orb.

Liotia (Arene) agenea n. s.

Plate 23, figure 3.

Older Miocene of the Chipola beds, Calhoun Co., Florida, Burns.

Shell small, with four whorls, the whorls tricarinate, the umbilicus wide, rapidly narrowing, funicular, the outer margin bordered by a crenate rib; suture distinct; transverse sculpture of fine, elevated, close-set lines, which are usually a little gathered up, close to the suture, into short wrinkles; aperture nearly circular, slightly thickened, the outer margin angulate from the ends of the keels. Alt. 2.0; max. diam. 2.5 mm.

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* Quart. Journ. Geol. Soc. 1874, p. 529.

This little shell is the precursor of *L. gemma* of the Newer Miocene and the variety *tricarinata* Stearns of the Pliocene and recent faunas. From them it differs in its much smaller size and relatively much wider umbilicus. It seems to be very rare in the marl.

The genus *Liotia* is represented in the Eocene by *L.* (*Solarium*) *granulata* Lea. As there was a *Solarium granulatum* of Lamarck, Conrad attempted to rectify matters, in 1834, by calling it *S. tricostatum*, and Orbigny, in 1850, proposed for it the name of *pseudogranulatum*. As it is not a *Solarium*, perhaps we may be permitted to go back to the earliest specific name. The species is not rare at Claiborne, in the horizon of the Claiborne sands, and is also found at Wood's Bluff, Ala. The *Solariorbis bella* Conrad, referred to *Delphinula* by De Gregorio, is a mere catalogue name without figure or description.

The figure of De Gregorio's *Delphinula conscionaria* resembles an extremely young *Natica* or *Polynices*, too immature for determination. The *Delphinula trochiformis* and *naticoides* of H. C. Lea, from the Miocene of Petersburg, Va., are extremely young specimens which have been a good deal worn, and seemed to the writer quite unrecognizable. I have carefully examined the type-specimens which are in the Philadelphia collection.

FAMILY UMBONIIDÆ.

Genus UMBONIUM Link.

There are no species yet reported from our Tertiaries which really belong to this genus as properly defined, yet in the deep waters of the West Indies a recent species is found, so that they may be expected to turn up. The species referred to *Adeorbis*, *Rotella*, *Umbonium*, etc., by Lea and others in the literature, belong to the group about to be discussed.

In his review of the *Trochidæ*, Mr. Pilsbry has called attention to the fact that in discussing the genus *Ethalia* in the Blake Report (p. 359) I had followed Carpenter in characterizing it by the species included under it by Adams, but differing from the two which served as his original types. It is, as Mr. Pilsbry suggests, not unlikely that *E. guamensis* may differ from the smaller and more pellucid species which have generally been referred to *Ethalia*, although, conchologically, the differences are chiefly of size and coloration. At all events, it will be convenient to consider the latter separately.

Vitrinella having been reserved for the small turbinate hyaline shells with an open umbilicus, large larval shell, and the aperture dilated and sinuated, and *Ethalia* for the large forms agreeing with *E. guamensis*, it remains to allot the several names which have been proposed for the remaining forms, in accordance with their characters and the law of priority.

Teinostoma Adams (P. Z. S., 1853, p. 183) has a depressed shell, with the umbilicus open when young, closed with a large, smooth callus in the adult, and with the aperture drawn away from the axis, expanded and angular or pointed at the periphery of the whorl. Type: *T. politum* Adams. This group has two sections beside the typical one—*Pseudorotella* Fischer (1857), in which the shell is small, the umbilicus closed and the aperture rounded instead of drawn out, and *Calceolina* A. Adams (1863), in which the aperture is drawn out, but not pointed at the periphery. *Parkeria* Gabb (1875) and *Megatyloma* Cossmann (1888) are synonyms of *Pseudorotella*. There remain still a number of species in which the young stages of *Teinostoma* are perpetuated, and which show generally an angle or ridge extending from the pillar into the umbilicus spirally, and which sometimes is produced into a thin broad keel, which might be taken for the umbilical wall, but really overshadows the perforation of the axis and nearly closes it. Others have the keel obscure, but the angle at the pillar compressed, as if it had been pressed while soft somewhat away from the aperture. The surface may be smooth or sculptured, the spire well-marked or involved in the last whorl, the umbilicus usually marked by an opaque or callous area about it, though this area may be concave, or not raised above the general surface. These shells are obviously closely related to the others, and were named by Conrad in 1865 (Am. Journ. Conch., p. 30) *Solariorbis*. *Delphinula depressa* I. Lea, his first species, may be regarded as the type. *S. bella*, another species which follows, is only a list-name; *S. lineatus* (Lea) Conrad is a *Solariella*, and the other example cited, *S. nitens* Lea, is a peculiar species of *Calliostoma*.

Among exotic species which may be referred to *Solariorbis* are *Teinostoma hosdenacense* Cossmann and *Rotella umbilicaris* Deshayes. The group, in short, comprises *Ethalia* of H. and A. Adams (*ex parte*), Carpenter, and my Blake Report, but not the restricted original *Ethalia* of A. Adams. *Leucorhynchia* Crosse (1867) is a *Solariorbis* in which the umbilical keel, in the adult, is so extended as to pass beyond the umbilicus, under the base of the shell, but without closing it. The type is a recent species from New Caledonia.

Dillwynella was described by me as a subgenus of *Teinostoma*, but, after much consideration, I have concluded that it is entitled to generic rank. It differs from the group represented by *Teinostoma* and *Umbonium* in possessing an epidermis, and may perhaps turn out to have quite different relations when the soft parts are known. Both these groups go back to the mid-Eocene in America, and are represented in the existing fauna.

In the preceding part of this paper, when the name *Ethalia* is used, as it is in a few places, the reader will understand that the group here termed *Solariorbis* is meant, and not *Ethalia* as now restricted to such forms as *E. guamensis*.

Section *Pseudorotella* Fischer.

This section is represented in the Claibornian by *T. subrotundum* Meyer and *T. angulare* Meyer; in the Jacksonian by *T. Verrillii* Meyer. In the Older Miocene we have *T. chipolanum* Dall; in the Chesapeake Miocene *T. nanum*, *T. subconicum*, *T. carinatum*, *T. lenticulare* and *T. umbilicatum* of H. C. Lea, and the following species:

Teinostoma milium n. s.

Chesapeake Miocene of Wilmington, N. C., Burns; Pliocene of the Caloosahatchie and Shell Creek, Dall and Willcox.

Shell minute, polished, smooth, depressed-conic, with three whorls; suture simple, not impressed; periphery evenly rounded, base moderately rounded, umbilicus open in the young, bounded by an obscurely angular ridge terminating at the pillar, in the adult filled with callus, the surface of which is somewhat concave; aperture nearly rounded, somewhat concavely flexuous at the periphery and produced above and below; margin somewhat oblique. Max. diam. 1.5; alt. 0.8 mm.

This little shell is well represented by the figure of *T. margaritula* Deshayes (An. s. Vert. Bas. Paris, 3, pl. 63, figures 9–11), except that it is slightly more depressed, the aperture more concave at the periphery and the umbilical callus less prominent. The spire reveals the whorls distinctly.

Teinostoma caloosaënse n. s.

Plate 23, figure 8.

Pliocene of the Caloosahatchie River, Florida, Dall.

Shell minute, polished, smooth; spire depressed, dome-shaped; whorls three, not differentiated in the profile; periphery rounded; base moderately rounded, the umbilical depression filled smoothly up to the general level by a smooth callus; aperture quite oblique, rounded below, pointed at the upper commissure, the body with a light coat of callus. Max. diam. 2.0; alt. 1.0 mm.

This species has the edge of the whorls so smoothly thinned out that the profile of the spire forms an unbroken arch or segment of a circle. It is larger than *T. milium* and has a different aperture.

Teinostoma chipolanum n. s.

Plate 23, figures 6, 7.

Older Miocene of the Chipola beds, Calhoun County, Florida, Burns.

Shell small, tumid, somewhat neritiform, three-whorled; surface polished with microscopic revolving striæ; dome of the spire slightly gibbous; a little flattened between the suture and the periphery; base flattish, the spiral striæ stronger below; aperture small, nearly circular, somewhat pointed at the upper commissure; umbilicus solidly filled with smooth callus, which extends across the body to the outer lip; inner lip at certain stages of growth separated from the callus by a small groove, at other times the surface is continuous and smooth. Alt. 1.0; max. diam. of base 2.3; min. diam. 1.8 mm.

This curious little shell is well distinguished by its gibbous form. The spirals are only visible in a good light and on a perfectly unworn specimen.

Teinostoma cryptospira Verrill.

Rotella cryptospira Verrill, Trans. Conn. Acad. vi. p. 241, 1884.

Post-Pliocene of North Creek, Little Sarasota Bay, West Florida, Dall; living off the coasts of North Carolina and Florida in 30 to 150 fathoms, U. S. Fish Commission.

This little shell resembles *T. umbilicatum* Lea in having the whorls nearly concealed by the thinned-out edge of the proceeding whorl, which is appressed nearly to the apex. The surface is smooth and polished. The fossils have been identified by comparison with a specimen named by the author, who has not yet figured his species.

Teinostoma opsitelotus n. s.

Plate 19, figures 5, 5 b.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox.

Shell small, solid, four-whorled; upper surface flattened, the suture distinct, narrowly marginate, appressed; surface polished, with fine spiral striæ in front of the suture, becoming obsolete toward the periphery; periphery evenly rounded; base full, obscurely spirally striate; umbilicus, except in the completely adult, rather large, subcylindrical, its margin formed by an obscure angle; in the adult it is completely filled by a flattish, somewhat irregular callus; aperture circular except at the upper junction of the lip with the body; pillar strong, vertical, broad at the umbilical angle; body with a moderate covering of callus. Alt. 1.3; max. diam. 3.3; min. diam. 2.5 mm.

The adults vary considerably in the size they attain, and also in the size of the umbilicus before it is filled up; the young often have a more or less distinct spiral rib on the upper surface, on which the suture is wound, but which becomes obsolete on the last whorl. The spiral striæ sometimes, but rarely, extend to the periphery, and are always stronger at the inner margins of the whorls both above and below. The figures represent a young shell before the umbilicus is filled; the adult shows in its place merely a not-prominent surface of callus.

Section *Solariorbis* Conrad.

The type of this group is the Eocene *T. depressum* Lea, a large and beautifully sculptured Claibornian species. It is especially marked by the punctate reticulated sculpture due to the intersection of spiral and transverse grooving. To this species Meyer has attached *T. rotula* Heilprin as a synonym. It seems somewhat doubtful that they can be identical, as no indication of reticulate or punctate sculpture is given by Heilprin in either description or figure. Other Eocene species of this section of the genus are, from Claiborne, *T.* (*Adeorbis*) *pignus* De Gregorio; from the Jacksonian, *T. quadrangulare* Meyer; *T. planulatum* H. C. Lea, of which *subangulatum*

Meyer may be a synonym; and *T. læve* Meyer, of which the author reports a variety *vicksburgense* in the Vicksburgian.

The Miocene and Pliocene species will now be described, and, as the last species cited under the preceding section was one which up to the latest moment of attaining maturity might seem to belong in *Solariorbis*, so the first species here described will be one which barely misses establishing itself as a *Pseudorotella*.

Teinostoma microforatis n. s.

Plate 23, figures 9, 10.

Older Miocene of the Chipola beds, Calhoun Co., Florida, Burns.

Shell large for the genus, with four or five whorls; surface polished, sculptured; spire flattened; upper surface of the whorl with two spiral subequal ribs, one close to and in front of the suture, the other near the periphery and having the suture laid upon it; surface between these ribs slightly convex, sculptured with numerous fine sharp spiral grooves crossed by numerous rather distant impressed lines of growth, producing a punctate effect at the intersections; periphery rounded, base moderately convex, with a sculpture similar to that of the spire, but stronger, increasing in strength and in the width of the interspaces toward the umbilical area, which is nearly smooth and evenly rounded; aperture rounded, oblique, angulated at the upper commissure and by the rib; pillar thin and short, at its base supported by a triangular thickening due to a stout projecting umbilical rib which overhangs and screens the small perforate umbilicus. Alt. of shell 2.3; max. diam. 4.7; min. diam. 3.7 mm.

The nucleus of this handsome little shell is swollen and prominent, almost as if it might be sinistral, and immersed in the spire. There is no callus on the pillar or umbilicus, and, viewed vertically from below, the shell seems imperforate, but under the shadow of the thick rounded umbilical rib there is a small perforate umbilicus, essentially as in *Leucorhynchia*.

The species is nearest *T. quadrangulare* Meyer, but has no angle at the periphery of the base, the umbilical area is proportionately smaller, and the end of the rib less broad and prominent. Meyer's species seems also to be a much smaller shell, and has a conical, not flattened, spire.

Teinostoma steiratum n. s.

Plate 23, figure 11.

Newer Miocene of the Cape Fear River, North Carolina.

Shell small, polished, solid, three-whorled; spire flattened above, obscurely microscopically spirally striate near the suture and umbilicus; early whorls with an angle on the upper surface, close to which the suture is wound, forming a narrow channel, but on the last whorl the angle becomes obsolete and the upper surface evenly rounded; periphery with a single narrow keel; base rounded, flattish, falling evenly into the simple subcylindrical umbilicus, which has no rib or keel and is surrounded by a smooth, not elevated, callous area; aperture rounded except at the upper commissure; body with a thin callus, pillar thick, concavely arched. Alt. 1.0; max. diam. 2.6; min. diam. 2.0 mm.

This species seems to be more nearly the size of *T. quadrangulare*, but differs in the basal characters. There is no rib or angle on the pillar, and the umbilicus is rather large for the size of the shell. More specimens might show at perfect maturity additional characters, but the species may easily be recognized by the simple rounded peripheral keel.

Teinostoma vortex n. s.

Newer Miocene of the Cape Fear River, North Carolina.

Shell very small, disk-like, of three and a half whorls; surface polished, sculptured only with numerous impressed incremental lines; first whorl rather prominent, subsequent whorls somewhat excavated in front of the inconspicuous appressed suture; last whorl slightly descending and somewhat expanded near the aperture; periphery evenly rounded, whorls full; aperture transversely ovate, oblique, thin-edged, a thin wash of callus on the body; pillar thin, not differentiated from the rest of the margin, externally with a broad, thin lamina, which is closely applied to the preceding whorl, but forms an ovate funicular umbilical area, more opaque than the rest of the shell, and having a minute central chink leading into the covered umbilicus. Max. diam. 1.7; min. diam. 1.2; alt. 0.6 mm.

A single specimen of this well-marked little shell was obtained from the marls, but was unfortunately smashed by the draughtsman before a figure was completed.

Teinostoma collinus n. s.

Plate 23, figure 14.

Newer Miocene of the Cape Fear River, North Carolina.

Shell resembling the preceding, but much more elevated and turbinate, the depression in front of the suture feeble, the incremental lines not impressed the umbilical lamina lower down on the pillar, so that it does not reach the preceding whorl, and the excavation above it is plainly visible, while the callous umbilical area formed by the lamina has a more irregular, obliquely wrinkled surface and rises above the whorl at its margin. The shell has four whorls, a polished surface and a circular aperture; the pillar-lip, apart from the lamina, is thin. Alt. of shell 1.3; max. diam. 2.0; min. diam. 1.5 mm.

A single specimen with the aperture imperfect but clearly different from any of the others was obtained. The general profile of the spire is domelike, the sutures being inconspicuous, and the whole shell is rather thinner than in most of the other species.

Teinostoma funiculus n. s.

Plate 23, figure 15.

Pliocene of the Caloosahatchie, Dall.

Shell small, of three or four whorls, polished, with a flattened spire; upper surface of the whorls near the outer edge bordered by a sharp rib which in the later whorls becomes an angle in front of which the suture runs; the space between the rib and the suture is flat and finely spirally striate; the whole shell is brilliantly polished, the rounded periphery is smooth, and the spiral striæ are again visible just outside the umbilical area on the base, or the whole may be striate; in the young shell there may be an angle on the periphery, but it usually becomes obsolete in the adult; aperture circular, hardly oblique, margins not thickened; umbilicus surrounded by a well-marked, not-much-elevated keel, wide, with vertically striated, rather convex walls. Alt. 1.0; max. diam. 2.4; min. diam. 2.0 mm.

This shell resembles the young of *T. opsitelotus*, but has a different umbilicus, which would seem not to be filled up at maturity, is smaller and has finer and sharper spiral striæ. The rib on the summit is much more prominent than in that shell. Still, we know as yet so little about the limits of variation in these small shells—and I have reason to believe it much greater than ordinarily supposed—that if it were not for the differences in the umbilicus I should have regarded *T. funiculus* merely as a variety of *T. opsitelotus*.

Teinostoma pseudadeorbis n. s.

Plate 23, figures 12, 13.

Chesapeake Miocene of the "*Striarca centenaria*" bed, at Temple Place, near Yorktown, Va., G. D. Harris.

Shell small, solid, with four rounded whorls, a rather depressed spire and generally *Adeorbis*-like form; whorls slightly impressed in front of the distinct suture, rounded at the periphery; sculpture of numerous fine, sharp grooves with wider rounded interspaces, tending to be feeble on the periphery and more distant on the base near the umbilicus, but otherwise rather uniform over the shell; these are crossed by fine incremental striæ, giving a somewhat punctate aspect to the grooves; base flattish, moderately rounded, the umbilical margin smooth and evenly rounded over, umbilicus narrow, deep, somewhat scalar; aperture wider than high, oblique, the pillar-lip not differentiated, but thickened; the body with a moderate callus, connecting the lips. Alt. 2.5; max. diam. 5.0 mm.

This interesting little shell might be taken for an *Adeorbis*, if it were not for the swollen nucleus and the thickened pillar-lip. A single specimen was obtained by Mr. Harris.

Genus **DILLWYNELLA** Dall.

Dillwynella Dall, Rep. Blake Gastr., p. 362, April, 1889; Bull. U. S. Nat. Mus. No. 37, p. 160, 1889. Type *D. modesta* Dall, pl. xxi. fig. 3.

Tiburnus De Gregorio, Faun. Eocen. Alabama, p. 143, 1890; subgenus of *Turbo*, type *T. naticoides* Lea.
Turbo sp. Lea; *Natica* sp. Conrad.

Dillwynella naticoides Lea.

Plate 18, figure 3.

Natica eborea "Conrad," Foss. Sh. Tert. Form., No. 4, p. 46, Oct., 1833; Cat. Tert. Sh. U. S. in Morton's Synopsis Org. Rem. Cret., App., p. 4, 1834; Orb., Prodr. Pal. ii. p. 346, No. 137, 1850.
Turbo naticoides Lea, Contr. Geol., p. 125, pl. iv. fig. 114, Dec, 1833.
Monilea eborea Conr. (MS. label), in S. I. Coll., not of Wagner.
Turbo (*Tiburnus*) *naticoides* De Greg., *op. cit.* p. 143, pl. 13, figs. 21 to 26, 1890.

Claiborne sands horizon of the Eocene at Claiborne, Alabama.

Shell small, turbinate, solid, polished, smooth, not pearly, of four or five whorls; suture distinct, not channelled; upper surface and periphery rounded; nucleus minute; sculpture only of faint incremental lines; base rounded, minutely perforate or with a deep, narrow pit in the umbilical region; pillar broad, slightly callous, with a faint groove behind it, passing insensibly into the lower lip; aperture oblique, lip not reflected; throat smooth. Alt. 6; max. diam. 7 mm.

Natica eborea, published by Say and Morton in Conrad's name, was not figured or recognizably described. Conrad himself afterward blundered in trying to identify it. The name of Lea, which was accompanied by a good figure, is therefore adopted here.

Owing to the similarity of the specific names and the circumstances above mentioned, Conrad seems to have confounded this species with Wagner's *Trochus eboreus*, which it does not resemble. It differs from the recent type of *Dillwynella* by its larger size, more elevated and compact form, but otherwise is extremely similar to it. There is a faint dimple of callus on the pillar in both, but it is more prominent in the recent species. None of the specimens show any trace of nacre, thereby agreeing with the porcellanous character of the recent *Dillwynella*. The only shell with which this is likely to be confounded is the *Calliostoma nitens* Lea, which is smaller, more depressed, more angulated at the periphery, and provided with a thick and very brilliant nacreous layer, which shines through the thin outer stratum of the shell in many specimens.

Genus COCHLIOLEPIS Stimpson.

Cochliolepis Stm., Proc. Bost. Soc. Nat. Hist. vi. p. 308, 1858.

The systematic position of this genus is not yet absolutely certain. The type is the following species:

Cochliolepis parasitica Stimpson.

C. parasitica Stm., Proc. Bost. Soc. Nat. Hist. vi. p. 308 (fig'd), 1858; Dall, Rep. Blake Gastr., p. 360, 1889.

Rare in the Caloosahatchie beds, Dall; living under the scales of a large annelid (*Acoëtes lupinus* Stm.) in Charleston Harbor, S. Car., Stimpson.

A single specimen of the typical species was found in the marls.

Cochliolepis nautiliformis Holmes.

Adeorbis nautiliformis Holmes, Post-Pleioc. Fos. S. Car., p. 93, pl. xiv. figs. 8 a, 8 b, 1860.

Newer Miocene of Duplin Co., N. Car., Burns; Post-Pliocene of S. Carolina at Cainhoy, Wando River, Holmes.

This is easily discriminated from the type by its rounder whorls and the greater amount of the spire left uncovered by the advancing whorl. It is also larger. Holmes, having two small species, unfortunately got his labels mixed or some error occurred by which a shell (*Vitrinella Holmesii* Dall) which has no resemblance to *Cochliolepis* is figured as Stimpson's species, while a genuine *Cochliolepis* is represented under the name of *Adeorbis*.

Cochliolepis striata Stimpson.

Plate 23, figures 16, 17.

C. striata (Stm. MS) Dall, Rep. Blake Gastr., p. 360, 1889.

Newer Miocene of Duplin Co., N. Car., Burns; of the Cape Fear River at Mrs. Guion's marl-bed, C. W. Johnson; living in Tampa Bay, Florida, at Egmont Key, Col. E. Jewett.

It is not improbable that further researches will reveal this species also in the Caloosahatchie beds.

FAMILY CYCLOSTREMATIDÆ.

Genus **VITRINELLA** C. B. Adams.

The place of this genus is still uncertain, and numerous incongruous species have been referred to it, even by its founder. The true *Vitrinellæ* conchologically seem very like the more porcellanous forms of *Cyclostrema*, so that I have adopted, provisionally, the present family to include the genus, as well as the more strictly holostomate types upon which it was founded.

Subgenus **Episcynia** Mörch.

Episcynia Mörch, Mal. Blatt. xxii. p. 155, 1875; as subgenus of *Solarium*; type *S. inornata* Orbigny, Moll. Cuba, p. 67, pl. xix. figs. 25–27. Recent in the Antilles.

The type is a small hyaline, depressed shell with a single serrated carina furnished with long, caducous epidermal cirrhi.

Vitrinella (Episcynia) multicarinata Stimpson.

V. multicarinata Stm. (MS.) Dall, in Rep. Blake Gastr., pp. 273, 361, 392, 1889. Recent on the Florida coast.

? *Architectonica gemma* Holmes, Post-Pleioc. Fos. S. C., p. 92, pl. xiv. figs. 6, 6 a, 6 b, 1860. Wando River marl-beds at Cainhoy, S. Car.; Post-Pliocene of Holmes.

? *Adeorbis carinata* Gabb, Geol. Top. Santo Domingo, p. 243, 1873.

Miocene of Duplin Co., N. Car, Burns; Pliocene of the Caloosahatchie River, Florida, and of the Cape Fear River, N. Car.; recent on the Southeastern coast of the United States from Hatteras to Florida, low water to 15 fathoms.

It is uncertain whether Holmes's species is identical with the recent shell and Pliocene fossils. The latter agree perfectly in being less elevated than Holmes's figure and in having more spiral sculpture. It is possible that his specimen was exceptional or his figure inaccurate, but, in the absence of his type, I do not feel authorized to definitely unite them. They are in any case closely related species. The North Carolina specimen was collected by Mr. Johnson at Mrs. Purdy's marl-pit on the Cape Fear River. The evidences of a possible mixture of Pliocene and Miocene at this place are so strong that the age for the present cannot be decided.

The type of Gabb's *Adeorbis carinata* is an *Episcynia* somewhat resembling the present species. It is, however, more probably identical with the type of the subgenus *V.* (*E.*) *inornata* Orb.

Genus **CYCLOSTREMA** Marryat.

Cyclostrema chipolanum n. s.

Plate 22, figure 35.

Older Miocene of the Chipola beds at Bailey's Ferry, Chipola River, Calhoun County, Florida, Burns.

Shell small, turbinate, with three or four rounded whorls; nucleus small, smooth, subsequent whorls sculptured with (between the sutures three) eight prominent spiral ribs with wider channelled interspaces crossed by well-marked lines of growth which are occasionally almost lamellose; suture distinct, not channelled, though the whorl in front of it is a little tabulated by the upper spiral rib; basal surface sculptured like the spire; aperture circular, expanded at the margin; pillar-lip thin; the space between it and the lowest spiral rib is excavated, but there is no umbilical perforation. Alt. of shell 2.25; diam. 2.3 mm.

This is a well-marked and characteristic little shell, notable for its bold, strong yet simple sculpture.

Genus **MOLLERIA** Jeffreys.

This genus differs from *Cyclostrema* in having the operculum more or less calcareous, and the aperture supplied, just within the margin, with a projecting edge or shelf against which the edge of the operculum fits. By this rim or ledge fossil specimens may be recognized, even if there is no operculum present. Under *Adeorbis* the reader will find one or two species referred to which, perhaps, would more appropriately find a place here, but without a greater amount of material for study I have hesitated to transfer them.

Molleria duplinensis n. s.

Plate 23, figure 18.

Newer Miocene at the Natural Well of Duplin County, N. Car., Burns.

Shell minute, turbinate, smooth or minutely granulose or shagreened, with four whorls; nucleus small; upper surface of the spire evenly rounded; suture distinct, the last whorl declining a little near the aperture; periphery and base evenly rounded to the margin of the umbilicus, which is formed by a rather prominent rib, above which the umbilicus is funicular; aperture circular, its outer margin angulated at the suture and at the end of the umbilical rib; internally the opercular shelf is well marked. Alt. of shell 1.5; max. diam. 2.0 mm.

The surface of this small shell is somewhat worn, but it suggests that, when in perfect condition, it may not be perfectly smooth, but rather microscopically sculptured.

Molleria minuscula n. s.

Chesapeake Miocene of St. Mary's River, Maryland, Clark.

Shell very small, with the general form of *Lunatia interna* Say, turbinate, fully rounded, with two and a half whorls; surface smooth, suture distinct, not deep; base rounded; umbilicus very small; aperture rounded, hardly thickened, the margin internally with a perceptible ledge for the edge of the operculum. Alt. 0.7; max. diam. 1.0 mm.

This shell is well distinguished by its extremely small size, smooth surface and small umbilical chink.

FAMILY NERITIDÆ.

Genus NERITA (Linné) Bruguière.

Nerita tampaënsis n. s.

Plate 17, figure 3.

Older Miocene of the Orthaulax bed, Tampa Bay, Florida, and of the Tampa limestone at La Penotière's Hammock, on Six-Mile Creek, a mile and a half south of Orient Station, six miles eastward from Tampa City, Florida, Dall and Burns.

Shell rather small, with a depressed spire and three whorls; surface varying from nearly smooth with obsolete spiral sculpture to strongly irregularly spirally ribbed with narrow rounded ribs separated by wider interspaces and crossed by more or less conspicuous lines of growth; there is no fine striation and the ribs are extremely irregular in size when strong, and become almost entirely obsolete in some specimens; they are more sparse on the upper surface than on the periphery; aperture half-moon-shaped, outer lip thickened, but not dentate; inner lip with a broad, rather thin callus with obscure tubercles on the lower portion; pillar thin, with a few obscure denticles near the middle. Alt. 10.0; max. lon. 12.5 mm.

The specimen figured happens to be nearly smooth; on the spire there are some obscure oblique wrinkles. A specimen from the hammock shows strong, irregular ribbing, of which there are only traces seen on the one figured. All the specimens obtained at Ballast Point, where it seems rare, seem to have been more or less worn before being fossilized. This is the first species of *Nerita* described from the Atlantic Tertiary rocks, and resembles some of the Pacific coast recent species more than it does the recent species of the Atlantic coast and the West Indies.

There are a number of Californian fossils of the genus.

Genus **NERITINA** Lamarck.

Neritina chipolana n. s.

Plate 23, figure 19.

Older Miocene of the Chipola beds, Chipola River, Calhoun Co., Florida, Burns.

Shell small, polished, smooth, with a low spire and three whorls; nucleus swollen, prominent, suture distinct; general form resembling that of *N. pupa* L.; aperture produced, the outer margin thin, the body with a moderately thick callus; at the base of the pillar-lip is a slight projection, outside of which the callus is impressed; pillar above this prominence irregularly and minutely denticulate, the teeth when continuously present numbering ten or twelve. Alt. of shell 5.0; max. diam. 5.3 mm.

This neat little shell retains its color-markings, which are composed of dark, narrow lines radiating from the axis and over the whorl in every conceivable form of zigzag or curve, either singly or in groups of three to five, either continuous or broken. In general, however, there is much more of the surface of an individual free from lines than covered by them—a feature apparently characteristic of this form. Some rare varieties of *N. virginea* Lam exhibit much such a style of painting, but in that species when little triangles are formed the line bounding the triangle behind is always broader than elsewhere, giving the effect of a shadow; in *N. chipolana* the lines are not widened. Size and coloration being considered, there is no recent American species which approaches this one very closely.

Neritina (Theodoxus?) edentula n. s.

Plate 19, figure 11.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox.

Shell small, smooth, or striated by incremental lines, with a depressed spire and about three whorls; aperture oblique, outer margin thin and sharp; body with a rather thick callus; pillar smooth or very obscurely striated, edentulous. Alt. 5.9; max. lon. 5.6 mm.

The type-specimen has lost its color-markings, but many of the other specimens show dark lineations, which differ from those of the preceding species in being less evidently radiating, more broken, and much more close-set.

The only other North American species which has an edentulous pillar-lip is *N. Skowalteri* Lea, a shell closely related to *N. fluviatilis* of Europe and having a different form of aperture. It is a recent species found, so far, only in the fresh water of the Coosa River, Alabama.

It is somewhat singular that none of the recent species of the region are found in the Caloosahatchie Pliocene, and is perhaps to be accounted for by the sandy shores, which are not favorable to Nerites. Gabb has mentioned *N. viridis* as found fossil in Santo Domingo, but has not specified the horizon or locality.

Superfamily ZYGOBRANCHIA.

Family PLEUROTOMARIIDÆ.

The Miocene and Pliocene of the Southern States have not yet offered any examples of *Pleurotomaria*, though there is every reason to suppose that they will eventually be found. In the Eocene a large and fine species, recalling *P. Adansoniana*, has been described by Tuomey (Proc. Acad. Nat. Sci. for 1852, p. 193, 1854) from the limestones of Wilmington, N. Carolina, under the name of *Trochus nixus*. It has never been figured, but a fine specimen is in the National Collection from the original locality. Conrad has also named a large species from the Shark River, New Jersey, Eocene as *P. perlata*, but it is hardly definitely established as yet. The family *Haliotidæ* is also, so far, unrepresented by species in the Floridian Pliocene, though Pourtales dredged a species in the Florida Strait which was associated with several other mollusks like *Bothrocorbula*, which are found not uncommonly in the Caloosahatchie beds.

Family FISSURELLIDÆ.

Subfamily FISSURELLIDEINÆ.

Mr. Pilsbry, in his revision of the *Fissurellidæ*, has pointed out that the typical subfamily does not antedate the Pliocene; as far as yet known, all the earlier forms belong to the subfamily *Emarginulinæ*. The collections upon which this memoir is based entirely sustain this view. In fact, so far, only two species are reported from our Tertiary which do not belong to the group just mentioned, and they are also found living in the same region.

Genus LUCAPINELLA Pilsbry.

Lucapinella limatula Reeve.

Fissurella limatula Reeve, Conch. Icon., f. 115, 1851.
Fissurellidea limatula Dall, Rep. Blake Gastr., p. 409, 1889.
Lucapinella limatula Pilsbry, in Tryon, Man. xii. p. 198, pl. 36, f. 13, pl. 61, figs. 6, 7, 8, 9. May 1891.

Older Miocene of the Chipola beds? Pliocene of the Caloosahatchie, Dall; living on the coast of the Southeastern United States southward from Cape Fear, N. Car., to the Florida Keys, and in the West Indies to Barbados, in 15–20 fathoms.

A fragment evidently of this genus, and which as far as it goes agrees well with the Pliocene specimens, was obtained by Mr. Burns at Chipola. The Caloosahatchie shells agree in the minutest particular with those of the same size from the recent fauna, but there is one specimen from the Caloosahatchie which measures 27 mm. long by 16 wide and 6 high, which is larger than any recent specimen I have seen.

Genus LUCAPINA Gray.

Section *Foraminella* Guilding.

Foraminella (Guilding MS.) Sby., Conch. Ill. Fiss., p. 4, 1839?

Chlamydoglyphis Pilsbry, in Tryon, Man. xii. p. 198, 1891.

Lucapina suffusa Reeve.

Plate 23, figure 22.

Fissurella hondurasensis Reeve, Conch. Icon., f. 70, 1851.

Fissurella suffusa Reeve, *ibid.* in *errata.*

Fissurella cancellata Sowerby, *ex parte*, Thes. Conch., p. 200, pl. viii. (243), fig. 187 only, 1862.

Glyphis cancellata Dall, Bull. U. S. Nat. Mus. No. 37, p. 170, 1889.

Lucapina cancellata Pilsbry, in Tryon, Man. xii. p. 200, pl. 63, figs. 1, 2, 3, pl. 37, fig. 58, 1891.

Fossil in the Pliocene of the Caloosahatchie, Dall, and Alligator Creek, Willcox; living from Marco, Florida (Hemphill), to Vera Cruz, Mexico, and in the Antilles, and the eastern coast of South America to Fernando Noronha (E. A. Smith).

Both the Sowerbys confounded this species with that afterward called *adspersa* Phil.; the name *cancellata* in the Tankerville Catalogue stands without any description or figure. In the Conchological Illustrations, in my opinion, we have figured, under the name of *cancellata*, a specimen of *adspersa*, the unpublished *Foraminella Sowerbii* of Guilding, or the *Lucapina elegans* of Gray, according to the elder Sowerby.

In the Thesaurus we have a specimen of *suffusa* (fig. 187) and one of *adspersa* (fig. 189) joined under the name of *cancellata*. The name of *suffusa* positively applies to the species now under consideration, while there is more or less doubt as to the others. I have therefore adopted the name in this place, pending more accurate information.

The fossil specimens happen to be extremely depressed, and by some accident were not recognized, until after a figure had been prepared, as identical with *suffusa*, but there is no doubt as to their relationship.

SUBFAMILY EMARGINULINÆ.

Genus FISSURIDEA Swainson.

Fissuridea Swainson, Malac., p. 356, 1840; Pilsbry, in Nautilus, v. p. 104, 1892.
Glyphis Carpenter, 1856; not of Agassiz, 1843.

In the Eocene this group is represented in the Claibornian by the handsome large *F. tenebrosa* Conrad, of which *F. claibornensis* Lea is a synonym; from Newton and Wahtubbee, Miss., Meyer and Aldrich have described *F. altior*. From the Vicksburgian *F. mississippiensis* is described by Conrad, and the same species occurs in the Older Miocene rocks of Northwestern Florida, in the form of casts, if correctly identified.

The approximation of the different groups of higher value than species, as we recede in time, is well illustrated by *F. tenebrosa*, where the cross bar behind the apical foramen has so deep a dint behind it that it seems difficult to say whether the species shall be referred to *Fissuridea* or *Puncturella*.

In the Older Miocene of New Jersey we have *F. Griscomi* Conrad; *F. chipolana* n. s., and *F. nucula* n. s., appear in Floridian rocks of the same age.

In the Chesapeake or Newer Miocene occurs *F. redimicula* Say, normally high, conical, with a rather small, very cylindrical foramen. A very young shell, probably of this species, forms the type of *Cemoria oblonga* H. C. Lea. The typical *redimicula* has the sculpture even and closely approximate, but from this, by the greater prominence of a few of the radial riblets, we pass to the variety *alticosta* Conrad (*alticostata* Meek). *F. catilliformis* Rogers (1839) is normally lower, and more compressed laterally and elongated, usually with a very large, rather oval, foramen; and close, compact, flattened sculpture. *F. marylandica* Conrad (1841) and *F. nassula* Conrad (1845) are synonyms. I have examined the types of both. A recent species *F. Tanneri* Verrill, has much the sculpture of *F. catilliformis*, but has a small, cylindrical foramen somewhat like *redimicula*, but smaller. *F. redimicula* and *catilliformis* are very closely related, and perhaps may prove to be local races of the same species. I find *F. redimicula* and *alticosta* most common in Virginia and *F. catilliformis* and *nassula* in Maryland. The latter extends to Murfreesboro', North Carolina, and the vicinity of Darlington, Peedee River and Goose Creek, South Carolina, and the upper bed at Alum Bluff in Florida. It is figured under the name of *redimicula* by Tuomey and Holmes. The Old Miocene *F. Griscomi* is a smaller, somewhat lower and more elongate species with a long-oval foramen, but also very closely related to the others.

Fissuridea carolinensis Conrad.

Plate 21, figure 7.

Fissurella carolinensis Conrad, Geol. N. Car., App., p. 22, pl. 4. fig. 1, 1875.
Fissuridea carolinensis Pilsbry, Nautilus, v. p. 106, 1892.

Newer Miocene of the Cape Fear River, North Carolina, Johnson;

Pliocene of the Caloosahatchie, Shell Creek and Alligator Creek, Florida, Dall and Willcox.

This is a fine species with, in its best condition, very strong radiating ribs with intercalary weaker ones, imbricated irregularly by the lines of growth. The foramen is elongate, keyhole-shaped or oval, and its inner callous border subtriangular, indented medially, behind. It is before the apex of the shell and looks distinctly forward. The shell reaches a length of 55, a breadth of 40, and a height of 23 mm. It seems to be especially abundant and fine in the marl at Shell Creek.

Fissuridea nucula n. s.

Plate 19, figures 9, 12.

Newer Miocene of Duplin Co., North Carolina, near the Natural Well, Burns; Pliocene of the Caloosahatchie, Dall.

Shell small, ovate-conic, the sides and ends declining evenly with hardly any arch, the foramen circular, small, its plane nearly horizontal; sculpture of numerous small, even, elevated, radiating riblets, with about equal interspaces, in which, by intercalation, the ribs gradually appear; these are crossed by little-elevated, rounded threads which minutely crenulate the ribs and sink into the interspaces; the threads are more close-set than the ribs, and the intersections are hardly elevated into nodules; interior smooth, the muscular impression distinct, the margin minutely crenulate, the foramen rounded, surrounded by a deltoid callus, behind which is an evident dint. Alt. 3.0; lon. 4.75; diam. 3.25 mm.

This neat little shell seems to be very common in the uppermost Miocene of North Carolina, but rarer in the Pliocene. The specimen figured is from the Pliocene, and happens to be less sharply sculptured than most of those obtained later, in which the interspaces are more distinctly channelled and the beading of the ribs more sharp than the figure indicates. This is shown by the series examined to be merely an individual variation.

Fissuridea chipolana n. s.

Plate 23, figure 21.

Older Miocene of the Chipola beds near Bailey's Ferry, Chipola River, Florida, and in the lower bed at Alum Bluff, Chattahoochee River, Burns; Newer Miocene of Duplin Co., North Carolina.

Shell ovate, slightly wider behind the foramen, with rather straight sides, slightly concave anterior and convex posterior slope; foramen oval or a little keyhole-shaped, sloping forward; sculpture of narrow, prominent, radiating rounded ribs, with wider interspaces and alternately smaller intercalary riblets, crossed by distant, regularly spaced, elevated concentric threads, which form nodules at the intersections; these nodules toward the periphery tend to become transversely flattened or pear-shaped, and in large specimens near the margin may assume an imbricated form; interior smooth, the margin crenulate in the young, in the full-grown rather sharply and coarsely denticulate radially; foraminal callus spade-shaped, slightly dinted behind. Alt. 7; lon. 15; diam. 9.5 mm.

This species much resembles *F. alternata* Say, but seems more depressed and elongated, and has the foramen habitually more anterior. It does not seem to attain so large a size as the recent specimens of *alternata*. It is undoubtedly the forerunner of that species.

Fissuridea caloosaënsis n. s.

Plate 21, figure 6.

Pliocene of the Caloosahatchie beds and Shell Creek, Florida, Dall and Willcox.

Shell large, depressed, with a link-shaped foramen which sometimes is distinctly keyhole-shaped; radiately sculptured with feeble, shallow, rather narrow sulci, between which the lines of growth are convexly looped toward the apex of the shell, and by regularly-spaced, rather close-set, impressed lines give the effect of being imbricated toward the foramen; under the lens the sculpture has the effect of combed wool, the rippled fibres lying in harmony with the incremental lines; interior smooth, the muscular impression strong, the foraminal callus having the outline of a Gothic window; its outer margin somewhat fimbriated or irregularly denticulated; margin of the shell feebly crenulated. Alt. 12.0; max. diam. 40.0; lon. 50.0 mm.

The specimen figured has been more or less decorticated. From a fragment collected by Mr. Willcox at Shell Creek the normal appearance of the sculpture has been described; there are no analogous recent species in the region. The nearest approach to it in the matter of surface-sculpture among recent species seems to be *Clypidella pustula.*

Fissuridea carditella n. s.

Plate 21, figure 11.

Pliocene of the Caloosahatchie beds, Dall.

Shell elongate-ovate, rather depressed, the foramen in the anterior half, which is somewhat narrower than the posterior portion; foramen elongated, keyhole-shaped; sculpture prominent and intricate, comprising strong radiating ribs, with narrower interspaces and much smaller intercalary riblets, which are crossed by sub-laminar concentric ridges, more distant near the apex, more crowded toward the base, and rather regularly spaced; near the apex is reticulated, with the radials predominant, but below it becomes more crowded; the intersections above are marked by transverse nodules, which gradually, as they advance toward the base, become more developed and hollowed basally, until near the margin, in a perfect, well-developed specimen, the appearance of the ribs suggests little heart-shaped cups, fitting partly into one another, and strung on the rib, somewhat like what is called by ladies "herringbone-stitch," except that the cups are symmetrical and not alternate on opposite sides of the rib; interior smooth; the foraminal callus subtriangular, somewhat concave behind; margin of the shell rounded and crenulate. Lon. 27.0; max. diam. 15.75; alt. 7.0 mm.

The nearest approach I know of to the elegant funicular imbrication of this shell, when perfect and well developed, is found on the anterior ribs of young specimens of *Cardium floridanum*, where similar imbrications occur, but more distantly arranged. The young shells are destitute of the peculiar sculpture, and recall the young of *F. chipolana*, though usually more depressed. The funicular sculpture is very delicate, and rarely preserved over the whole of the shell. The figure, necessarily rather reduced in size, gives but an imperfect idea of the sculpture when magnified. The young show a smooth spiral nucleus of one whorl.

Fissuridea alternata Say.

Pliocene of the Croatan beds in North Carolina, the Waccamaw beds, South Carolina, Johnson, and perhaps of the Caloosahatchie, Dall; Post-Pliocene of Florida, and living on the coast of the United States from Cape Hatteras southward to the Florida Keys, westward to Texas, through the Antilles, and south to the island of Fernando Noroñha, on the eastern coast of Brazil.

The specimens from Tilly's Lake, South Carolina, are unmistakable; the single young specimen from the Caloosahatchie must be regarded as doubtfully determined.

Genus **PUNCTURELLA** Lowe.

I have already called attention to the close approximation of the Claibornian *F. tenebrosa* Conr. to *Puncturella*. A genuine species of *Puncturella* is reported by Meyer from the Jacksonian under the name of *P. Jacksonensis*. The specimen figured is so small that some doubt attaches to the generic determination, since the very young of all these *Fissurellidæ* exhibit the *Puncturella*-form until the enlargement of the foramen removes the spiral apex. Some of the deep-water species of *Puncturella* found living off our coast are found fossil in the Pliocene of Italy. One such species, *P. rostrata* (belonging to the subgenus *Fissurisepta*) Seguenza, was reported by Dr. Watson in the Challenger Report. On an examination of typical specimens named by Watson, and a comparison of them with fossil Italian specimens named by Professor Seguenza, it was obvious that two species were concerned, and in the Blake Report I named the American recent form *P. triangulata*. As I was working with the specimens authentically named, I paid no attention to figures, but in citing Watson's name inadvertently cited his figure also, not noticing that it was a copy of Seguenza's, and not taken from one of his own specimens. This oversight on my part, to which Mr. Pilsbry has called attention, was the less inexcusable since Watson himself calls attention to some of the differences between his specimens and those sent him by Professor Seguenza.

Puncturella noachina L. is reported from the Pleistocene of Beauport, in Labrador, but I do not know of any species in the Tertiary of our Southeastern coast.

Genus **EMARGINULA** Lamarck.

Subgenus **Rimula** Defrance.

Emarginula (Rimula) caroliniana n. s.

Plate 20, figure 10.

Rimula caroliniana Dall, this memoir, p. 213, Jan., 1892.

Pliocene of the Waccamaw beds, South Carolina, Johnson.

Shell small, thin, oval, with the apex nearly over the posterior margin; with a small smooth nucleus of a single whorl; moderately elevated, the anterior slope elegantly convex, the posterior slope short and excavated; sculpture of subequal, rounded radiating threads, swerving slightly to the right, crossed by subequal concentric ridges, which near the apex are slightly irregular, but toward the base present an even reticulation slightly nodulous at the intersections; foramen narrow, long, with a marked fasciole, situated a little nearer the anterior margin; interior smooth, the fasciole slightly convex, the foramen prolonged a little forward by a short groove. Alt. 2.0; lon. 5.0; max. diam. 3.25 mm.

This is a very elegant little species, related to the *R. frenulata* Dall of the recent fauna, but shorter, rounder, with the foramen more central and with a somewhat different sculpture.

Subgenus **Emarginula** s. s.

A single species is known from the Claibornian, *E. arata* Conrad, and another from the Eocene of California, *E. radiata* Gabb. To these a third is now added from the Pliocene of Florida.

Emarginula Pilsbryi n. s.

Plate 21, figures 8, 8 a.

Pliocene of the Caloosahatchie beds, Florida, Dall.

Shell small, thin, elevated, with the apex in the posterior third; nucleus smooth, hardly forming a whorl; anterior slope arched, convex, posterior shorter, concave; sculpture of low, alternated, rather wide, not dichotomous, radiating ribs with narrower interspaces, crossed by numerous close-set, rather wide, obscure concentric ridges; the latter are narrower and more crowded near the apex, and wider and more irregular nearer the base; the intersections are somewhat tumid, but not nodulous; fasciole convex like a rib; the notch deep, narrow, nearly medial; interior smooth, the margins of

the notch thickened, the fasciole represented by a shallow groove; margin of the shell reflecting the external sculpture. Alt. 3.0; lon. 5.5; diam. 4.0 mm.

This pretty little species is nearest allied to *E. Rollandi* Fischer of the recent fauna, but the character of the sculpture through its various mutations is perceptibly different and the shell is smaller and proportionally more elevated.

It is respectfully dedicated to Mr. H. A. Pilsbry, to whom we owe an important revision of the *Fissurellidæ*, among other valuable contributions to the science.

Order PTEROPODA.

SUBORDER THECOSOMATA.

This group was inadvertently overlooked in its proper connection, as it should have preceded the order *Opisthobranchiata* (Part I., p. 14), to the members of which this group is more or less intimately related. As there can be no reasonable doubt that species of *Pteropoda* date from the very early Paleozoic rocks, I am unable to follow the superficial conclusions of some recent morphologists who would subordinate the group into separate sections of the later *Opisthobranchiata*.

Very few genuine Pteropods have been described from our Tertiaries. Lesueur, in 1829, figured (Walnut Hills Fossil Shells, pl. i., fig. 12, a, b) a form which has since been described by Meyer under the name of *Styliola hastata*, which, however, belongs to the genus *Creseis*.

Gabb named a Miocene fossil from Santo Domingo *Planorbella* (not of Haldeman) which has subsequently received the name of *Valvatella* from Mörch (*non* Gray), and *Valvatina* Borneman. The species *P. imitans* is possibly related to *Oxygyrus*, or may be the Planorboid stage of a *Cæcum* like the *V. parisiensis* of the Paris basin, and not a Pteropod.

From the Eocene of the Claiborne sands come *Creseis hastata* Meyer (also found in the Vicksburgian and Red Bluff beds), *C? nimba* and *C? ebla* De Gregorio. The last two look like fragments of *Dentalia*, and the typographical errors of the references are so bad that it seems impossible to tell which figures are referred to. At all events, more information is necessary before either shell can be regarded as a Pteropod.

From the Jacksonian we have *Creseis simplex* Meyer (as *Styliola*) and a form, perhaps not a Pteropod, which Meyer has named *Styliola corpulenta*. If a Pteropod, it should be referred to *Creseis*.

From the Miocene of Santo Domingo, Gabb has described *Cavolinia* (*Diacria*) *bisulcata*, *Cleodora* (*Balantium*) *undulatum* and *Styliola sulcifera*, which is a genuine *Styliola*. From the Miocene of Costa Rica he reports *Creseis bicostata* under the name of *Styliola*. He has also described, as a "*Triptera*," *Vaginella clavata*, from the Miocene of California. Professor Holmes has described from the Post-Pliocene of South Carolina a *Cavolinia*

Tuomeyi, but the shell figured is immature and probably the young of *C. gibbosa* Rang, still found living on the coast. Dr. Meyer's *Bovicornu*, the larval form of a Cæcid wrongly referred by him to the *Pteropoda*, has been already (p. 296) discussed.

There would appear to be no reason, in the case of pelagic shells like Pteropods, why they might not, after having once gotten into equilibrium with their environment, persist unchanged almost indefinitely, since they are free from the influence of geological changes which affect the shores, and the sea must have been very much the same for an incalculable period of time.

FAMILY CAVOLINIIDÆ.

Genus **VAGINELLA** Daudin.

Vaginella chipolana n. s.

Plate 23, figures 4, 5.

Older Miocene of the Chipola beds on the Chipola River, one mile below Bailey's Ferry, Calhoun Co., Florida, Burns.

Shell small, polished, marked only with fine incremental lines; posterior end truncate, the foramen small, circular; on each side of it, extending in a direct line a little more than one-third the length of the shell, is a fine, threadlike keel, which gradually fades away; transverse diameter nearly twice the antero-posterior diameter; shell inflated, the ventral surface more so than the dorsal, but the dorsal and ventral plates resemble one another more nearly toward the anterior end; anterior foramen as wide as the shell, marginate, the dorsal margin with a median flexure, the ventral simply arched, the whole margin in the completely adult shell somewhat reflected. Alt. of shell 5.5; transverse diameter 3.2; antero-posterior maximum diameter 1.75 mm.

This neat little shell appears to be rather common at the locality mentioned, but is rarely found in an absolutely perfect state. It is not sufficiently like the Californian species to need comparison.

Genus **CUVIERINA** Boas.

Cuvierina columella Rang.

Older Miocene of the Chipola beds, from the lower bed at Alum Bluff, Chattahoochee River, Florida, Burns; living in both oceans from N. lat. 43° to S. lat. 40°, floating at or near the surface.

Two specimens of this well-known and characteristic Pteropod were obtained, as noted, by Mr. Burns. One of them is as perfect as if collected yesterday from the surface of the sea, though, of course, less translucent. They are absolutely indistinguishable from the recent shell. The specific name of this species is a good Latin word, and stands in no need of alteration into "columnella," as some inexperienced writers have hastily concluded.

The genus is more commonly known as *Cuvieria*; a name preoccupied in another department.

In the Proceedings of the Academy of Natural Sciences for 1884 (p. 110), Dr. O. Meyer has described a minute fossil—which he regards as a Pteropod, perhaps a subgenus of *Cuvierina*—under the name of *Tibiella Marshii n. g. et sp.* It was obtained from the Claiborne sands, but, as I have not had an opportunity of examining the type, I prefer to leave its relations undiscussed.

Genus CRESEIS Rang.

This genus is distinguished from *Styliola*, which has a dorsal groove and twisted shell, by its simple, slender, conical shell, hardly distinguishable from some forms of *Dentalium*, except by the fact that it is usually not quite rectilinear or curved in a perfectly even manner, and, when perfect, is closed at the smaller end.

Creseis recta Lesueur.

Styliola recta (Lesueur MS.), Blainv., Man. Mal. ii. p. 655, 1827; Lesueur, Walnut Hills Foss. Sh., pl. 1, fig. 12, 1829; Verrill, Trans. Conn. Acad. v. p. 556, 1882.
Creseis acicula Rang, Ann. Sci. Nat., l. xiii. p. 318, pl. 17, fig. 6, 1828.
C. clava and *C. acus* Rang.
Creseis recta Dall, Bull. U. S. Nat. Mus. No. 37, p. 80, No. 13, pl. 66, fig. 118, 1889.

Chesapeake Miocene of the "Tellina bed," Temple Place, York River, Virginia, Harris; living, between N. lat. 48° to S. lat. 40°, pelagic in the Atlantic Ocean.

The specimens cannot be discriminated from the recent form, which is, moreover, quite variable within the narrow limits prescribed by its simple character.

Lesueur figured this by the side of his Vicksburg fossil (*C. hastata*) to show the difference. He referred both to his genus *Styliola*, but a year or two later Rang proposed his genus *Creseis*, founded on this very species, and, the type of *Styliola* being a grooved species (*S. subulata* Q. and G.), when the distinction was recognized, both names were retained.

Subclass ISOPLEURA.

Order POLYPLACOPHORA.

Superfamily EOCHITONIA.

The antiquity of the Chiton stock is extremely great. In America they are recorded (*Priscochiton canadensis* Billings) from the Lower Silurian. The subject has been reviewed, so far as the groups earlier than the Tertiary are concerned, by the writer in the Proceedings of the U. S. National Museum for 1881, pp. 279–291. On the Pacific coast, where *Chitonidæ* abound in the recent fauna, the Pleistocene contains numerous fossil remains of still existing species. Putting all the foregoing aside, in the Tertiary of the Eastern States but very few species are known.

The best-known species is *Chiton eocenensis* Conrad, from the Claibornian, which has several synonyms. A single species, *C. transenna*, is described by H. C. Lea from the Chesapeake Miocene of Petersburg, Va. His description and figure are insufficient to enable one to refer the species to its proper place in the family. To these I am now able to add one species from the Older Miocene and one from the Pliocene formation.

FAMILY CHITONIDÆ.

Genus CHITON Linné.

Type *Chiton tuberculatus* Linné.

Subgenus Trachyodon Dall.

Insertion-plates broad, strong, divided by deep grooves into numerous bifid "teeth," or fimbriæ, in the head and tail-plates; central valves with the plates continuous, thin and flat from the jugum to the girdle, where they have a single slit, on each side of which the plate is strong and fimbriated; sculpture marked, with the lateral areas distinct, the tail-plate with a prominent mucro. Type, *C. eocenensis* Conrad.

Chiton (Trachyodon) eocenensis Conrad.

Chiton eocenensis Conrad, Proc. Acad. Nat. Sci. Phila. vii. p. 266, 1855; Am. Journ. Conch. i. p. 212, pl. xx. fig. 6, 1865; De Gregorio, Mon. Claib., p. 170, pl. 16, fig. 39, 1890 (tail-valve).

Chiton antiquus Conrad, Morton, Syn. App., p. 6, 1834 (name only); Proc. Acad. Nat. Sci. Phila. vii. p. 266, 1855; Am. Journ. Conch. i. p. 212, pl. xx. fig. 7, 1865; De Gregorio, *op. cit.* p. 170, pl. 16, fig. 38, 1890 (tail-valve).

Chiton? prostremus De Gregorio, *op. cit.* p. 170, pl. 16, figs. 40-42, 1890 (head-valve).

Eocene of the Claiborne sands at Claiborne, Ala., Conrad, Johnson, Burns, etc.

The species is quite wide in front, and narrows toward the tail—at least so far as the exposed surface of the valves was concerned, since the widest tail-valve does not equal the width of the average head-valve in a considerable number of specimens. The central valves are very short and wide; the central area on each side the jugum is longitudinally sculptured with about twenty-five coarse, elevated, sometimes dichotomous, rounded ridges with narrower interspaces; I have not seen the jugal portion; the lateral areas are sculptured with six or seven radiating ridges otherwise like those of the central area; the lateral part of the insertion-plate has six or more fimbriations on each side of the notch; the head-plate is short and very wide (3.6 x 11.0 mm.), the median portion in advance of the outer ends, slightly upturned, but not mucronate; the sculpture consists of about thirty dichotomous radii, obscurely nodulous, or vermicular, and separated by narrower interspaces; the eaves are thin and very narrow; when the surface is worn the nodular prominences give place to punctations (*C. antiquus*); insertion-plate exhibiting long, strong paired ridges, corresponding roughly to the ribs of the upper surface.

and reinforced behind by a transversely striated, low ridge of callus, behind which again the jugal area is radiately striated. The tail-plate is somewhat variable in form (as in recent Chitons); an average specimen measures 8.5 mm. wide by 5.0 mm. long; the sculpture is of the same character as that on the other valves, smooth or punctate on the mucro, radial in front of the mucro, and longitudinal on the lateral areas; there is sometimes a dimple at the centre of radiation under the mucro, and the prominence of the apex varies considerably; the anterior laminæ are connected by a narrow bridge across the jugal region; the insertion-plate resembles that of the head-valve, and has about thirty fimbriations, many of them double.

I have been thus detailed in describing this species since there is no description or figure by which its systematic place might be determined. Conrad's figures, copied by De Gregorio, merely indicate the form and sculpture of the upper surface of the tail-valve. De Gregorio's figure of the head-valve is made from a poor and broken specimen.

I have selected the name of *eocenensis*, of the two simultaneously applied to this species, as more characteristic and based on a perfect specimen; *C. antiquus* is extremely modern compared with the paleozoic species, and was described from a worn valve. The form here described is identified from specimens sent to the Smithsonian by Conrad many years ago.

I have suggested a subgeneric name for this species, since I find its characters not corresponding to the assemblage presented by any of the recent forms, though evidently allied to the restricted genus *Chiton* and to several of its sections. No distinct slits are observable in the terminal plates, they are fimbriated, but, with the exception of the denticular processes which constitute the fringe, cannot be said to have any insertion-plates in the proper sense of the word.

Genus **ISCHNOCHITON** Gray.

Ischnochiton tampaënsis n. s.

Plate 23, figure 23.

Older Miocene of the Orthaulax bed at Ballast Point, Tampa Bay, Florida, Dall and Crosby.

Head-plate elevated, about 4 mm. wide and 3.3 mm. long, the upper surface convex, simple, with fine obscure radial granulations; toward the periphery the lines of growth are somewhat impressed, giving rise to a few concentric ridges; eaves well-marked, insertion-plate thin, sharp, with eleven narrow, clean-cut slits.

Central valves with an angle of about 100°, the surface minutely granular and with microscopic pittings; central area sculptured with (on each side about five) sparse, distant, longitudinal, chain-like threads, somewhat irregularly disposed; lateral areas obscure, faintly marked by one or two obsolete radii, or none; dorsal ridge rounded, submucronate; width of valve 6.5;

length 3.0 mm.; sutural laminæ thin, sharp, smooth, continuous with the insertion-plates, interrupted (1.5 mm.) at the jugum, the edge nearest the jugal area minutely serrate; insertion-plates distinct, with a single sharp, clear-cut slit, the portion of the plate behind the slit with its edge minutely serrate, bearing about six denticles, the portion in front of the slit entire; below the valve is simple, smooth, the jugum with an entire edge; the mucronation is strengthened underneath with a sort of triangular gusset of shell-substance.

I have taken for granted that the head-valve kindly presented by Mr. Crosby, and the central valve found by myself, belong to the same species. They have the dorsal angle about the same, and there are no apparent incompatibilities between them. When we consider that both are silicious pseudomorphs, it is marvelous that they should show the details mentioned. In the absence of the armature of the girdle and the tail-valve, it is impossible to refer the species to its particular section of the genus, which may be *Trachyradsia*, or some other of the groups showing Radsioid tendencies in the insertion-plates.

The worn head-valve of a species apparently belonging to this genus was found in sand from the Newer Miocene or Older Pliocene of the Great Dismal Swamp in Virginia. It has no surface-sculpture except concentric lines of growth, is wide and short, with strong insertion-plate showing eleven slits. It is, however, too imperfect to name.

Superfamily OPSICHITONIA.

FAMILY MOPALIIDÆ.

Genus ACANTHOCHITON Leach.

Acanthochiton spiculosus Reeve.

Chiton spiculosa Reeve, Mon. *Chiton*, pl. 9, fig. 47, No. 47.
Phakellopleura (*Acanthochites*) *spiculosa* Shuttl., Berner, Mitth. 1853, p. 203.

Fossil in the Pliocene of the Caloosahatchie River, Florida, Dall; living on the Gulf of Mexico from Cedar Keys southward to the West Indies, Hemphill, Dall and others.

A fragment of a central valve was obtained in the marl, which agrees fairly well with the corresponding part of a valve of the above-mentioned species. The specimen is too imperfect to make the identification certain, but it is at least probable.

CLASS SCAPHOPODA.

Order SOLENOCONCHIA.

FAMILY DENTALIIDÆ.

This is a very ancient group, and all of its genera yet existing in the recent fauna appear to be represented in the American Tertiary.

To the students of the fossils a few words of caution may be useful, especially as several excellent paleontologists have at times been led into error by unfamiliarity with the facts to be gained by a study of the recent forms.

Stoliczka has divided the group into a number of genera and two subfamilies—a proceeding which future researches may justify; but, from an examination of a large number of recent species, I am led to suspect that the differences upon which they are chiefly based, such as the supposed forms of the foot in *Siphonodentalium* and *Dentalium* proper, are less important than one would suppose from the few published figures, and require further investigation before they can be safely used in systematic work. At any rate, for my present purpose, I prefer to retain the old nomenclature. The researches of Sars have shown that the arched side of the shell is to be regarded as ventral and the concave side dorsal, but to avoid confusion in comparisons I have not corrected here the terms in general use, which are the exact opposite of these.

The posterior end of the shell in *Dentalium* may be circular or ovate and evenly truncate, oblique, undulated, fissured in the median line, or with slits, lateral or ventral, or both.

The most usual form is that which is evenly transversely truncate; the next most common style is one in which there is a dorsal wave, or sulcus, or even a narrow slit of some length. The other combinations are less common. In a wide sense these variations depend upon the form of the mantle-edge or internal lining of the shell, which is an extremely contractile membrane capable of secreting shelly matter. This, like the shell, may be simply tubular, sulcate, undulated, etc., and when the shell is absolutely perfect the posterior end reflects the form of the membrane which secreted it, and which is known from observations on the recent shells to be capable of repairing damages to the calcareous tube which protects it.

The modifications of this part, therefore, are, as a rule, merely of specific value, and even in some cases are known to fluctuate widely in different individuals of the same species. The genus *Siphonodentalium* is said to have its posterior end always more or less fissured, but few of the supposed *Siphonodentalia* have had their soft parts accurately recorded, and the variability in *Dentalium* leads one to doubt if the rule is necessarily invariable in the other group. In *Cadulus* the orifice is known to differ between different species.

Another modification of the orifice has given rise to much misconception. Species with very thin shells usually live buried in soft mud which measurably protects them, but others with heavy shells appear to be more versatile; at all events, if the small end of the shell is accidentally broken off, the animal can repair it, and in species which have a simply tubular mantle and a thick shell the repairs take the shape of a small tube projecting from the blunt end of the large one, as it is impossible for the mantle to secrete a shell which is as large and thick as the original at the point of truncation. I have examined a great many recent *Dentalia*, and have never seen a specimen in which the "tube-in-tube" was not obviously the result of the above process, and I believe it always to be so. Such forms as *D. bitubatum* Meyer, from the Jacksonian Eocene, and several recent forms illustrate the conditions mentioned. *D. tarentinum* is especially liable to such breakages and repairs. It will be understood that it is not asserted that, from a peculiar fragility or liability to transverse breakage in a species, this condition may not be almost habitual with the adults of that species; but it is undeniable that no one has ever recorded a specimen with the posterior end entirely unbroken and yet possessing the supplementary tubule.

Another form of repair is sometimes observed in species which normally have a dorsal wave or sulcus in the posterior orifice. Here not only will the broken tip be, as it were, double-lipped, but a slight absorption will take place in the middle line above, corresponding to the sulcus, even in the solid shell of the truncation. Such a state of affairs has been figured by Meyer (Bull. Ala. Geol. Survey, I., pl. 1, fig. 2 a and pl. 3, fig. 2 a) in specimens of *D. Leai* and *D. Danai* Meyer, but it is never what may properly be called normal, though occasionally it may have become habitual.

Those who have studied large numbers of *Dentalia* will have been struck by the extreme sharpness and tenuity of the posterior portion of the young shell, which is almost invariably lost long before maturity has been reached, and will realize that only a carefully graded series connecting the very young with the adult will give anybody the means for describing the normal form of the posterior orifice with exactitude and accuracy.

Still another pitfall is to be avoided in studying the characters of the posterior part of the shell. As has been stated, the posterior orifice often has a dorsal slit, very narrow and prolonged in some cases. But it often happens that erosion, especially in specimens from deep water, modifies and sometimes simulates such slits, introducing them where they normally should not be or lengthening them abnormally. There seems to be a peculiarity of some kind in the external prismatic layer of *Dentalium*, which lends itself to the propagation of erosion in longitudinal lines very much more effectively than at right angles to such lines. Hence we see specimens of a species, normally provided with a short slit, exhibiting an enormously long slit, or, starting at some little defect of the posterior margin, a narrow line of erosion, simulating a slit, may run a long distance up the shell. These abnormalities may usually be discriminated by comparison with numerous specimens of the same species. In cases where the student has only one or two specimens, he should refrain from putting reliance on characters which may be abnormal as a basis for describing new forms or for discriminating old ones.

It may also be added that it rarely happens that smooth species do not show at least a little sculpture near the posterior end, or that sculptured ones do not show a modification of the sculpture toward the anterior end. Hence a broken fragment from either part of the shell can rarely be relied upon to give differential characters for the species as a whole. In the same species, among the sculptured ones a good deal of variation in the strength of the sculpture between different specimens is extremely common, and should always be allowed for.

Genus **DENTALIUM** Linné.

In the Eocene of Claiborne, the horizon of the ferruginous sands affords five species of *Dentalium* which are well characterized. These are *D. thalloide* Conrad (*alternatum* Lea), *D. arciforme* Conrad (*D. Leai* Meyer), *D. blandum* De Gregorio, and *D. minutistriatum* Gabb (*D. annulatum* Meyer). *D. blandum* is shorter, smaller, thinner, with finer and less prominent sculpture than *D. alternatum*. *D. arciforme* Conrad is smooth, but toward the posterior end is sometimes microscopically longitudinally striated for a short distance. The posterior orifice is originally circular, subsequently with a wide sulcus dorsally and ventrally; when truncate and repaired it has a curious bilabiate supplementary inner margin which has been figured by Meyer. *D. minutistriatum* Gabb usually occurs in fragments, which are more slender and straighter than similar pieces of *D. arciforme*. The Texas specimens of *minutistriatum* are sometimes more sharply striated than the Claiborne shells, and those from the older Eocene Prairie Creek beds are more distinctly annulate. But these differences merge into one another even in the same locality. The species is found in the Prairie Creek beds, on the Sepulga River, and other places in Alabama, and Lee County, Texas. Another nearly smooth species from the Eocene of Alabama, Mississippi, Louisiana and Texas is *D. microstria* Heilprin. *D. bimixtum* De Gregorio is probably a fragment of it. *D. thalloide* Conrad (*D. alternatum* Lea) is very common in the Claibornian at Claiborne, near Clarksville and Wood's Bluff, Alabama, Wahtubbee and Newton, Miss., and Creole Bluff, Louisiana. *D. asgum* De Gregorio is synonymous. More than equally abundant is the *D. mississippiense* Conrad of the Jackson and Vicksburg Eocene, which is also found at Martin Station in Florida. The Prairie Creek beds also contain a pretty species, 9 to 10 mm. long, and about a millimeter in greatest diameter, which I have called *D. Eugenii*, in honor of Prof. Eugene A. Smith, State Geologist of Alabama. It is notable for its quadrangular section, with the convex side of the shell a little narrower than the concave side, the four angles pronounced, the surface between them longitudinally sharply striated, the anterior orifice oblique, and the posterior transverse and internally circular and simply truncate. The shell is rather solid for one of such small size, and strongly arcuated. *D. annulatum* Meyer has a name several times preoccupied, which is of the less importance since his shell is probably a young specimen of *minutistriatum* in which the longitudinal sculpture has not developed, as often happens. *D. bitubatum* and *D. Danai* Meyer, with *D. gnizum* De Gregorio, are all dubious Eocene forms. *D. densatum* Conrad, from some unmentioned Eocene locality, is perhaps a fragment of *D. microstria* Heilprin. *D. turritum* Lea is an immature *Cadulus*. *D. subcompressum* Meyer seems to be a valid species of the Jackson and Vicksburg Eocene, identifiable by its smooth surface and oval section.

D. incisissimum Meyer and Aldrich, from Wahtubbee, is described from a small fragment as cylindrical, smooth, polished, and with a long dorsal slit behind.

In the Miocene the species are more numerous. A large number have been described by Gabb and Guppy, from the Antillean Older Miocene, most of which are still unfigured.

Dentalium attenuatum Say.

D. attenuatum Say, Journ. Acad. Nat. Sci. Phila. iv. p. 154, pl. viii. fig. 3, 1824; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 105, pl. 25, f. 1.
D. dentale Conrad, Fos. Tert. Form., p. 78, pl. 44, fig. 9; not of Linné.
D. duodecenaria Conr., Proc. Acad. Nat. Sci. 1862, p. 570, 1863.

Chesapeake Miocene of Maryland, Virginia, North Carolina, South Carolina, and the Ecphora bed at Alum Bluff, Chattahoochee River, Florida; Pliocene of Costa Rica, Gabb.

This widespread and well-known species is closely allied to *D. dentalis* L., of Southern Europe, from which, however, it seems to me distinct. It is somewhat doubtful if the Costa Rica shell is identical.

Dentalium carolinense Conrad.

D. carolinense Conr., Proc. Acad. Nat. Sci. Phila. 1862, pp. 288, 570, 1863.

Chesapeake Miocene of North Carolina, Conrad; of James River, Va., Burns; of the upper bed at Alum Bluff, Chattahoochee River, Florida, Burns; and of the artesian well at Lake Worth, S. E. Florida.

This species, which has not been figured, is readily distinguished from *D. attenuatum* by its larger size, fewer (8 to 11) ribs, and much broader interspaces, and generally coarse and rude appearance. It reaches a length of 40 to 45 mm., a maximum diameter of 5 mm., and has a very thick, earthy and little-curved shell.

Dentalium Danai Meyer?

D. Danai Meyer, Bull. Ala. Geol. Survey, p. 64, pl. 3, f. 2, 1886.

Eocene of the Jacksonian, Ala., Meyer; Older Miocene of the lower bed at Alum Bluff, Florida, Burns; Chesapeake Miocene of Plum Point, Md., Darlington C. H., S. Car., and Duplin Co., N. Car., Burns.

It is impossible to distinguish between the fragments received as author's specimens of *D. Danai* and a smooth species not uncommon in the Miocene. The characters of the type-specimen of *D. Danai* are duplex. First the shell was truncated behind, and on the thick truncate margin of the posterior orifice a sulcus was worn or produced by absorption in front and behind. Then the animal changed his tactics, and, abandoning the attempt to modify the old broken margin, secreted a small tube after the fashion of a "jury-mast." It will be obvious to any one who inspects Dr. Meyer's figure that, after the supplementary tube had been made the animal could not have produced the sulci in the old margin outside of it. Consequently, the purely individual and accidental nature of the characters of the posterior orifice as described by Dr. Meyer cannot be denied. Very likely his shell represents a valid species, but so far we have no means of identifying it except by specimens furnished by the author. It is possible the smooth Miocene form may be different from *D. Danai*, but we cannot be sure of this until complete specimens of the latter have been collected and described or distributed.

Dentalium disparile Orbigny.

D. disparile Orb., Moll. Cuba, ii. p. 302, pl. xxv. figs. 14-17, 1842; Dall, Blake Gastr., p. 424, 1889.
D. antillarum, this essay, p. 211; not of Orbigny.

Older Miocene of the Chipola beds, Calhoun Co., Florida, and of the lower bed at Alum Bluff, Burns; Newer Miocene of North Carolina; Pliocene of the Waccamaw beds, S. Car., Johnson; of the Caloosahatchie beds, Florida, Dall and Willcox.

This well-marked species at the posterior end is circular, with the exterior crenulated by the ribs. By this feature it is distinguished from some of the allied species whose posterior section is polygonal. It was inadvertently referred to in the preface as *D. antillarum*.

Dentalium leptum Bush.

D. leptum Bush, Trans. Conn. Acad. vi. p. 470, pl. xlv. figs. 18, 18 a, 1885; Dall, Blake Gastr., p. 421, 1889.

Older Miocene of the Chipola River, Calhoun Co., Florida, Burns; living from Cape Hatteras to Charlotte Harbor, Florida, in 2 to 50 fathoms, sand or mud; U. S. Fish Commission.

This pretty little shell will doubtless be found in the Newer Miocene and Pliocene beds when sufficiently searched. The Chipola specimens do not seem to offer any characters by which they may be discriminated from the recent shell.

Dentalium calamus Dall.

Dentalium calamus Dall, Blake Gastr., p. 421, 1889; Bull. 37 U. S. Nat. Mus., p. 76, No. 8, 1889.

Pliocene of the Caloosahatchie, Dall; living in four fathoms at Turtle Harbor, Florida, Dr. Rush.

Dentalium filum Sowerby.

D. filum Sby., Thes. Conch., p. 99, pl. 225, fig. 45, 1856; Jeffreys, P. Z S. 1882, p. 60; Dall, Blake Gastr., p. 419, 1889.
D. gracile Jeffreys, Ann. Mag. N. Hist., July, 1870; not of Meek.

Older Miocene of the Chipola beds, Calhoun Co., Florida, Burns; Pliocene of Calabria, Seguenza; living in the North Atlantic and Mediterranean in 20 to 1093 fathoms, and off the coast of North Carolina at various stations of the U. S. Fish Commission in 17 to 124 fathoms.

This elegant little shell is easily recognized by the regular annulations by which it is sculptured, and its straight and slender form. It has an enormous range both in space and time.

Dentalium agile Sars var. oleacinum Dall.

D. agile M. Sars, Dall, Blake Gastr., p. 418, 1889.
Antalis agilis G. O. Sars, Moll. Reg. Arct. Norv., p. 102, pl. xx. fig. 9, 1878.

Pliocene of the Caloosahatchie and Shell Creek (rare), Dall and Willcox; living in the North Atlantic from Norway to the Straits of Florida in deep water.

The specimens appear to agree in form, shape, size, etc., with authentic specimens of *D. agile*, except that while *agile* proper has a smooth surface, the present form has the exterior polished. Without more material the permanency and value of this character cannot be determined, but should it prove to be specifically different, the varietal name now given may be raised to specific rank.

Dentalium caloosaënse n. s.

Plate 23, figure 24.

Pliocene of the Caloosahatchie and Shell Creek, Florida, Dall and Willcox.

Shell slender, solid, not polished, moderately curved, the orifices circular; sculpture begins at the small end, which is a rectangular prism with equal flat sides and the angles dorsal, ventral and lateral, with, occasionally, in truncate specimens, a short, smooth circular supplementary tubé projecting from the truncate surface; the four angles soon become four flat-topped, square-sided, prominent ribs, between which four more, and then eight more, smaller but similar ribs appear by intercalation; these ribs become obsolete about the anterior third of the adult shell, beyond which the surface is marked only by concentric incremental lines. Lon. of adult 50.0; ant. diam. 4.5; post. diam. 1.0; perpendicular of the dorsal arch 7.5 mm.

This species recalls *thalloide*, *attenuatum*, the recent *Gouldii* and *dentalis*, but agrees in its combination of characters with none of them. It is, perhaps, nearest *D. Gouldii* Dall, which is a proportionally longer and more slender shell living in 12 to 150 fathoms from South Carolina to Barbados.

Dentalium prisma n. s.

Plate 15. figure 5.

Rare in the Pliocene marl of the Caloosahatchie River, Florida, Dall.

Shell small, stout, not polished, rather acutely pointed behind, four-sided; the posterior end begins as a four-sided rectangular prism, with one of the sides dorsal, and rapidly enlarges with a moderate arch; the flat sides soon become impressed so that the angles stand out from them and present the appearance of posts; the interspaces toward the anterior end are a little rounded in the middle line; the posterior orifice is circular, not sulcate or slit, the anterior one subrectangular; all the specimens are broken, but the total length of an adult appears to be about 20 to 25 mm. Max. vertical diam. 2.5; diam. of posterior end 0.3 mm.

This species recalls the recent *D. platamodes* Watson, from the deep waters of the West Indies, which is, however, rounded when young and more arcuate, while on the sides there is more or less longitudinal striation, the angles are broken up into several threads, and the anterior section by the greater width and medial swelling of the ventral plane is pentagonal and not quadrate. *D. Eugenii* Dall, from the Prairie Creek Eocene, is nearer *D. platamodes*, having the dorsal plane narrower than the others, but the ventral plane is arched so that the section is keystone-shaped, and the sides are covered with sharp longitudinal striation.

Dentalium callipeplum Dall.

D. callipeplum Dall, Rep. Blake Gastr., p. 419, pl. xxvii. fig. 12 b, 1889; Bull. U. S. Nat. Mus. No. 37, p. 76, No. 4, plate 27, fig. 12 b, 1889.

Pliocene of the Caloosahatchie beds, Dall; living from South Carolina to Grenada, W. I., in 16 to 175 fathoms.

A single specimen of this fine shell was found in the marls.

Dentalium caduloide n.s.

Plate 23, figure 25.

Chesapeake Miocene of St. Mary's River, near the town of St. Mary's, Maryland, Willcox and Harris.

Shell small, thin, slightly curved, smooth but not polished, marked only with incremental lines which cross the tube somewhat obliquely; shell cylindrical, posterior orifice small, circular, the margin without notch or sulcus, rarely even perceptibly deviating from a circle except when worn or chipped. Lon. of shell 10 to 12; max. diam. 1.3; min. diam. 0.5 mm.

This curious little shell is found in large numbers in the St. Mary's marl, and would at once be referred to *Cadulus*, were it not that there is no trace of a cingulum, nor any tumidity or compression near the anterior end. Perhaps it should be referred to *Siphonodentalium*.

Genus CADULUS Philippi.

Cadulus Philippi, En. Moll. Sic. ii. p. 209, 1844. Type *C. ovulum* Ph.
Gadila Gray, P. Z. S. 1847, p. 159.
Gadus Rang, Deshayes, *non* Linné.
Helonyx Stimpson, Am. Journ. Conch. i. p. 63, 1865.
Dischides Jeffreys, Ann. Mag. Nat. Hist. 1867, xx. p. 251.

Since *Cadulus* is the oldest name, it must take precedence of later ones which represent merely minor divisions of the genus of which *Cadulus* is the type. That is to say, if *Pulsellum* and *Cadulus* are to form portions of a single genus, this genus must be called *Cadulus*, and the other name, which dates only from 1868, must be regarded as a subgenus or section of *Cadulus*. This very obvious rule has not been observed as consistently as could be wished, though a little reflection will show that it must be regarded as necessary.

It is impossible to discriminate, in dealing with fossil species, between those belonging to *Cadulus* proper and *Siphonodentalium*. The anal orifice of the shell may be waved or simple on its margin in different specimens of the same species, while those which have the margin cut by several slits or notches exhibit considerable variation in the details, as has already been shown by Fischer. The forms treated of here will therefore be referred to *Cadulus*, though it is by no means improbable that more than one genus is represented among them. The posterior orifice, as far as I have been able to judge from material in different stages of growth, is always circular at first; as the shell grows, in many species, it becomes dorso-ventrally somewhat compressed, and if there are to be sulci in the posterior margin they appear, being first shallow waves and gradually deepening by absorption into slits in those species which have slits. Some stop in the first stage, others in the second, others proceed to the third. If the slits are deep and wide, the little points of shell between them are very easily broken off, and thus it frequently happens that the aperture is reduced to its original simplicity. Then the process of producing the sulci begins again, and so the cycle repeats itself. As the tube grows, it reaches a point where the cingulum or greatest equatorial diameter is secreted, from which it diminishes to the anterior orifice. The section of the cingulum is usually, but not invariably, circular, even in species which are compressed behind and before the equator; the completed aperture is often circular while the shell a little way behind it is more or less compressed. Or the aperture, from being oblique to the axis, may appear circular when a straight section would result in an oval outline.

Altogether, it will be observed that the description and estimation of species in this group—especially among fossils, where perfect preservation and large numbers of specimens may not be had for the asking—are beset with difficulties, and in the present instance the writer is by no means confident that he has reached in all cases a correct conclusion, notwithstanding his best efforts in that direction. It is also uncertain, as yet, whether mere size is a specific character in this group; or whether, as in *Cypræa*, *Marginella*, etc., dwarfs occur in the midst of a large number of normally uniform specimens.

In the Eocene one of the earliest and most characteristic of our species is *C. turgidus* Meyer, from the Prairie Creek beds and Matthews' Landing, Alabama. *C. coarctatus* Lam. is referred to in the early literature, but is a European species not known to exist in our Tertiaries. Gabb named a species from the Eocene of Wheelock, Texas, *subcoarctatus* (*Ditrupa* " *subcoarcuata* " by a typographical error in the original) which, as nearly as I can judge, is the same as that subsequently named *abruptus* by Meyer and Aldrich. The latter is known from Newton, Wahtubbee, Claiborne, Wood's Bluff and Meridian, Miss. It is notable for having the smaller end lightly longitudinally striated in most specimens.

I have an undescribed new species from the Eocene of Lee County, Texas; *C. compressus* Meyer, from the Jacksonian, is merely a list-name, not having, as far as I have been able to discover, ever been described or figured. *C. newtonensis* Meyer and Aldrich was described from the Eocene of Newton, and is probably the same as *C. jacksonensis* Meyer of later date. *C. corpulentus* and *quadriturritus* Meyer are from the Red Bluff beds, and, with *C. juvenis* and *depressus* of the same author, from the Jacksonian and Claiborne sands, respectively, appear to be good species. *C. turritus* Lea, from Claiborne, described from an immature specimen, does not seem to be the same as any of the other Claiborne shells, while *C. vicksburgensis* Meyer does not seem to have been found in the Older Eocene.

In the Older Miocene three species are known, one of which is represented only by immature specimens. The Chesapeake Miocene of Alum Bluff offers two species, neither of which is identical with the two known from Maryland and Virginia beds of the same age. The Pliocene, so far, affords but a single species, which, curiously enough, seems to be the only one of our fossil species which can be strictly identified with any of the recent forms of our coast.

Cadulus newtonensis Meyer and Aldrich.

C. newtonensis M. and A., Cin. Journ. Nat. Hist. ix. p. 41, pl. ii. fig. 3, a, b, 1886.
C. jacksonensis Meyer, Bull. Ala. Geol. Survey, p. 65, pl. iii. fig. 8, a, b, 1886.

Eocene of Newton and Jackson, Miss., Meyer and Aldrich; Older Miocene of Chipola River, Calhoun Co., Florida, Burns; and Chesapeake Miocene of Jones's Wharf, Patuxent River, Maryland, Harris.

The points between the sulci seem particularly liable to fracture, and very few of the specimens preserve them, the majority appearing to have a plain, circular posterior orifice.

Cadulus vicksburgensis Meyer.

C. vicksburgensis Meyer, Bull. Ala. Geol. Survey, p. 65, fig. 6, 6 a, 1886.

Newer Eocene of Vicksburg, Miss., Meyer; Older Miocene of the Chipola beds, Chipola River, Calhoun Co., and the lower bed at Alum Bluff, Appalachicola River, Florida, Burns.

The denticulations of the posterior orifice are feeble compared with most of the dentate species. A more cylindrical variety was represented by a few specimens, among many, from the Chipola River, and most of those from Alum Bluff, but the difference is hardly great enough to dignify by applying a name to it.

Cadulus thallus Conrad.

Dentalium thallus Conr., Journ. Acad. Nat. Sci. vii. p. 142, 1834; *Ib.*, Fos. Shells of the Tert. Form., p. 78, pl. 44, fig. 5, 1845; Tuomey and Holmes, Pleioc. Fos. S. Car., p. 106, pl. 25, fig. 3, 1857; Emmons, Rep. Geol. Surv. N. Car., p. 274, fig. 189, 1858.

Chesapeake Miocene of Jones's Wharf, Patuxent River, Maryland, Harris; of the James and York Rivers, Virginia, Lea, Conrad, etc.; of Duplin Co., N. Carolina, Burns; of South Carolina, Tuomey and Holmes, and of the upper bed at Alum Bluff, Florida, Burns.

This is the commonest and most widespread species of the Newer Miocene. It is very close in general form to the recent *C. carolinensis* Bush, but the latter has a circular anterior aperture, and the denticulations of the posterior orifice are much deeper and more irregular. Meyer has referred to this species (Proc. Acad. Nat. Sci. Phila. 1884, p. 112) the *C. pandionis* Verrill, and to the latter Jeffreys has applied the name *C. Olivii* Scacchi. But *C. Olivii* and *pandionis* are very different species, and the genuine *pandionis* is shorter and less attenuated behind, and has a circular and not an oval anterior aperture.

Cadulus sp. indet.

Older Miocene of the Chipola beds, Calhoun County, Florida, Burns.

This species, which, though evidently different from the two others named from the Chipola beds, is only represented by half-grown specimens, has its posterior end attenuated and a good deal curved and shows a dorsal, ventral and two lateral notches at the margin; the shell is circular in section, increasing gradually and evenly in diameter forward to the end of the growth attained, a length of about 5.0 mm. The maximum diameter is about 1.25 mm.

Cadulus quadridentatus Dall.

C. quadridentatus Dall, Bull. Mus. Comp. Zool. ix. p. 36, July, 1881.

C. incisus Bush, Trans. Conn. Acad. Sci. vi. p. 471, pl. xlv. fig. 20, June, 1885; Dall, Bull. U. S. Nat. Mus. No. 37, p. 76, No. 26, pl. 41, fig. 20, 1889.

C. quadridentatus Dall, Blake Gastr., p. 428, pl. xxvii. fig. 5, 1889.

Pliocene of the Caloosahatchie River, Florida (rare), Dall; living on the coast of the Southeastern United States from Cape Hatteras southward to the west coast of Florida, to Fernando Noroñha and the mouth of the Rio La Plata, South America, U. S. Fish Commission.

The denticulations of the posterior orifice are very variable in strength, and there are sometimes six instead of four. The recent shell has a yellowish silky lustre, but never seems to have the brilliant polish of some of the other species.

Cadulus floridanus n. s.

Plate 23, figure 26.

Chesapeake Miocene of the upper bed at Alum Bluff, Appalachicola River, Florida, Burns.

Shell of moderate size, polished, little arched, section behind the cingulum circular; in front of it, including the mature aperture, slightly dorso-ventrally compressed; cingulum not differentiated, equator slightly anterior to the mid-length of the shell; margin of the circular posterior orifice simple, or very slightly undulated; anterior orifice of the adult oval. Lon. of shell 10.0 mm.; max. diam. 2.0; dorso-ventral diam. of anterior end 1.0; of posterior end 0.6 mm.

Compared with *C. pandionis*, this species is longer, straighter, less attenuated anteriorly and less abruptly tapered from the equator, while the different form of the aperture has already been referred to. It varies in length somewhat, but on the whole the specimens are very uniform.

Cadulus floridanus var. **Burnsii** Dall.

Chesapeake Miocene of the upper bed at Alum Bluff, Frank Burns.

Shell smaller, but exactly resembling the type in form, except that the equator is slightly more emphasized. Lon. 7.0; max. diam. 1.5; anterior aperture 0.8; posterior aperture 0.5 mm.

If it were not that there seems to be a gap in the matter of size between this form and the type which my specimens do not fully bridge over, I should hardly have felt it necessary to name it.

ERRATA.

Page 219, line 2 from top, for "Part I." read "Part II."

Page 255, line 10 from bottom, for "N. Carolina" read "S. Carolina."

Page 278, line 13 from top, for "*C. Whitfield*" read "*C. Whitfieldi.*"

Page 278, line 27 from top, for "*C. georgiana*" read "*C. georgianum.*"

Page 313, line 13 from top, for "Turritella striata Holmesii" read "Turritella Holmesii."

Page 360, line 28 from top, to the other Eocene localities add "Nummulitic beds of the Ocala limestone, Ocala, Florida, Willcox."

Page 361, line 13 from top, after "Vicksburg, Miss.," strike out the rest of the paragraph.

Page 368, line 16 from bottom, add: "Additional specimens kindly submitted by Mr. Aldrich seem to indicate that *Polynices onusta* Whitfield is distinct from *Natica aperta* of the same author, though this does not settle in the negative the question as to the presence of a callus in some specimens of *N. aperta*. As the specific name of the latter is preoccupied in its own subgenus, and its chief distinguishing characteristic is the strength and prominence of the incremental lines, I propose for it the name of *Polynices* (*Mammilla*) *rugifera*. *P. onusta* seems to be referable to the sub-genus *Neverita.*"

Page 371, line 28 from top, for "*Natice eborea*" read "*Natica eborea.*"

Page 405, line 11 from top, for "*humilis*" read "*humile.*"

Page 418, line 2 from bottom, for "*parasitica*" read "*parasiticus.*"

NOTE.

For the benefit of foreign readers, it may be noted that the lower part of the Chattahoochee River is known as the Appalachicola; different maps give in some cases a different extension to these two names.

The prefatory remarks pp. 201-217 were separately printed and distributed January 20, 1892. The printing of the descriptive text which follows was begun in July, 1892.

EXPLANATION OF THE MAP.

The map of Florida herewith is reproduced from that published in Bulletin 84 of the U. S. Geological Survey, by permission of the authorities of the Survey.

It represents, approximately, the distribution of the Tertiary rocks as they would appear if the superficial coating of vegetation, humus and sand was removed. Otherwise, hardly anything of the geology could be represented on a map of this scale, as outcrops and rock-surfaces are extremely rare in Florida, as is well known.

It is hardly necessary to say that the outlines of the strata as delineated have not been continuously followed, for this in Florida is impossible, owing to the semitropical vegetation, swamps and sand by which the vast majority of the surface-area is covered.

What has been done is this: As many observations as possible have been made, along river-banks, and in every locality where any outcrop of rock could be found by diligent inquiry or personal search with the time and means available. The results at each station have been platted on a large map of the State as small spots of color corresponding to the different formations. Many localities have been reached by means of correspondence, which it was impossible for the writer to visit personally; and the sections made and specimens furnished by courteous correspondents have greatly aided in mapping the less-known and accessible parts of the State. The areas thus indicated, taken in connection with the topography and the known general features of structure of the peninsula, have been connected by lines, and the areas thus enclosed colored accordingly. The result is an approximation to the truth which in its general features is probably as accurate as can be hoped for until a minute survey of the State has been completed, which will necessarily be a labor of years.

It should be stated that the observations are by no means equally distributed over the whole surface of the State. The extreme northeastern portion and the region south of the Caloosahatchie and east of the Kissimmee River (except the immediate sea-coast) are but little known, and the same is true of the region between Sopchoppy and the Suwannee River. On the other hand, the region between the Suwannee and Peace Creek has, owing to the personal explorations of a number of geologists and the prospecting carried on in search of phosphates, been quite generally and fully explored, and the general distribution of the formations is likely in future to be corrected chiefly in minor details. The section along the Appalachicola River is also quite thorough. In short, the map represents a reconnaissance of the geology of the region for which many of the details may be found in the Bulletin before referred to.

It may be noted that in many places the limestone rock has been removed by solution through the action of rain-water and carbon dioxide, leaving the subjacent rocks protruding through a covering of gravel consisting of the silicified débris of the dissolved beds. In certain depressions Pliocene clays have remained undisturbed, while elsewhere removed by the weather. It is to factors such as these that we owe the small patches of Eocene and Pliocene which are mapped north of the main Eocene area. Doubtless there are many more of these, but only those observed have been mapped; their area being somewhat exaggerated in order that they might be visible on the small scale of the map.

To still further illustrate the structure of the peninsula, the bathymetric lines showing the depths of the adjacent sea have been added to the map from the Reports of the United States Coast Survey.

The name of Alligator Creek, a Pliocene locality often referred to in the text, does not appear on the map. It is the small stream entering the bay from the eastward immediately below Punta Gorda.

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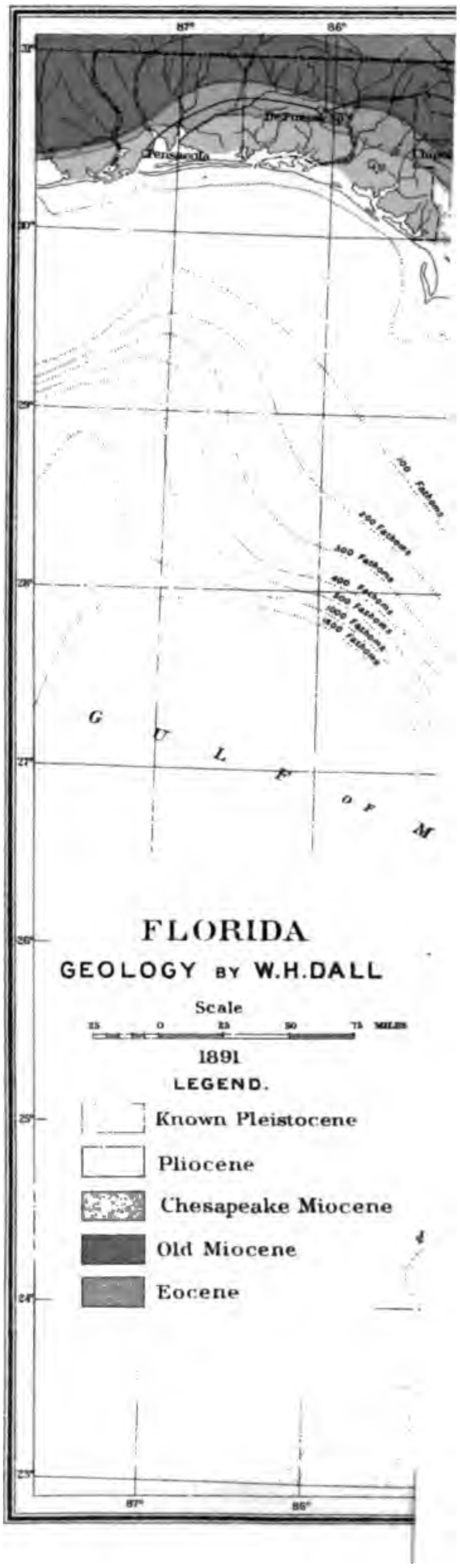
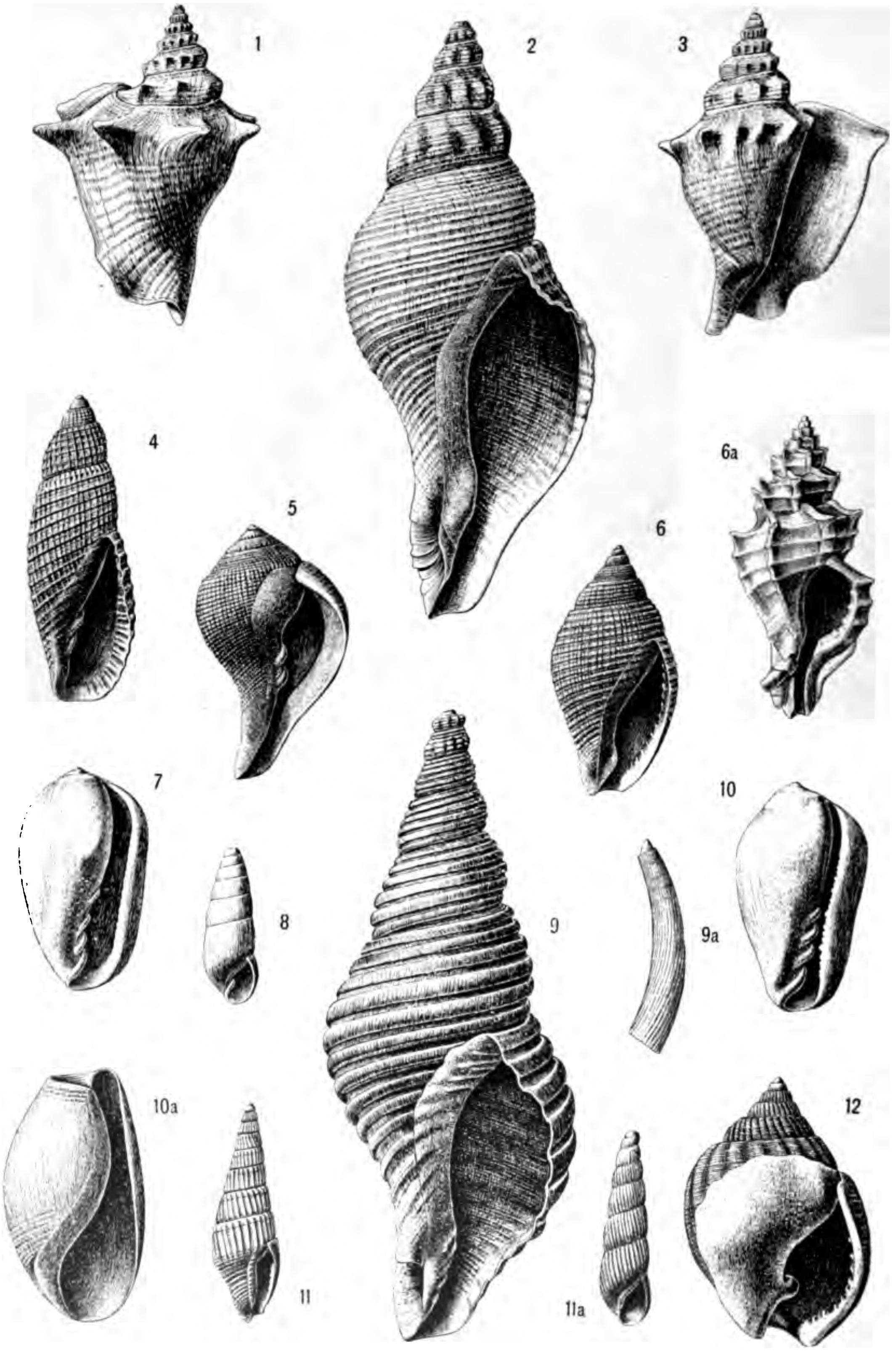




TERTIARY MOLLUSKS OF FLORIDA.

PLATE XIII.

NOTE.—The figures immediately preceding the page-reference represent the actual length in millimeters of the longest dimension of the object as seen in the figure. The drawings were made at different times and with the view of bringing out the characters of each specimen distinctly, rather than with that of their being strictly comparable in size among themselves. Thus it has happened that the real sizes of the specimens bear no constant relation to the size of the figures, and a smaller species may be represented by a figure larger than that of a larger fossil. The numerals in the reference, therefore, except where otherwise stated, give the exact length of the greatest dimension, whether breadth or height, and enable one to compare the sizes without having to refer back to the description in the text. The plates are numbered continuously with those of Part I. Plate 23, to which references occur in the text, will be published in Part III., which will conclude the work.

Fig. 1. *Strombus chipolanus* Dall, adult, dorsal view ; 65.0 mm.; p. 263.
Fig. 2. *Fasciolaria acuta* Emmons ; 120.0 mm.; p. 229.
Fig. 3. *Strombus chipolanus* Dall ; 65.0 mm. ; p. 263.
Fig. 4. *Perplicaria perplexa* Dall ; 17.5 mm. ; p. 228.
Fig. 5. *Glyptostyla panamensis* Dall ; 30.0 mm.; p. 253.
Fig. 6. *Pisania* (*Celatoconus*) *nux* Dall ; 18.0 mm.; p. 235.
Fig. 6 a. *Trophon* (*Aspella*) *engonatus* Dall ; 22.0 mm.; p. 243.
Fig. 7. *Marginella onchidella* Dall ; 15.0 mm.; p. 226.
Fig. 8. *Syrnola attenuata* Dall ; 3.3 mm.; p. 252.
Fig. 9. *Fasciolaria elegans* Emmons ; 122.0 mm.; p. 231.
Fig. 9 a. *Cæcum tortile* Dall ; 6.3 mm. ; p. 301.
Fig. 10. *Marginella eulima* Dall; 13.0 mm.; p. 225.
Fig. 10 a. *Bulla striata* var. *attenuata* Dall ; 23.5 mm.; p. 219.
Fig. 11. *Anachis styliola* Dall ; 16.0 mm. ; p. 242.
Fig. 11 a. *Turbonilla protracta* Dall ; 4.0 mm.; p. 261.
Fig. 12. *Nassa Johnsoni* Dall ; 22.0 mm. ; p. 241.

PLATE XIV.

Fig. 1. *Drillia schismatica* Dall; 20.5 mm.; p. 222.

Fig. 1 a. *Drillia hoplophorus* Dall; 17.3 mm.; p. 221.

Fig. 1 b. *Drillia aphanitoma* var. *oxia* Dall; 16.0 mm.; p. 222.

Fig. 2. *Drillia myrmecoön* Dall; 10.0 mm.; p. 220.

Fig. 2 a. *Drillia sigela* Dall; 16.0 mm.; p. 223.

Fig. 2 b. *Drillia aphanitoma* Dall; 21.5 mm.; p. 221.

Fig. 3. *Fusus caloosaënsis* Hp., typical, elongated Floridian form; 62.0 mm.; p. 234.

Fig. 3 a. *Clava caloosaënsis* Dall; 24.5 mm.; p. 291.

Fig. 3 b. *Fusus equalis* Emmons, typical form; 90.0 mm.; p. 234.

Fig. 4. *Cerithium glaphyrea* Dall; 16.0 mm.; p. 283.

Fig. 4 a. *Fusus caloosaënsis* Hp., stouter variety; 70.0 mm.; p. 234.

Fig. 5. *Volutella dacria* Dall; 5.0 mm.; p. 226.

Fig. 6. *Glyphostoma Johnsoni* Dall; 10.0 mm.; p. 223.

Fig. 7. *Cancellaria sericea* Dall; 16.0 mm.; p. 224.

Fig 7 a. *Cancellaria sericea* Dall; viewed from above; 11.6 mm.; p. 224.

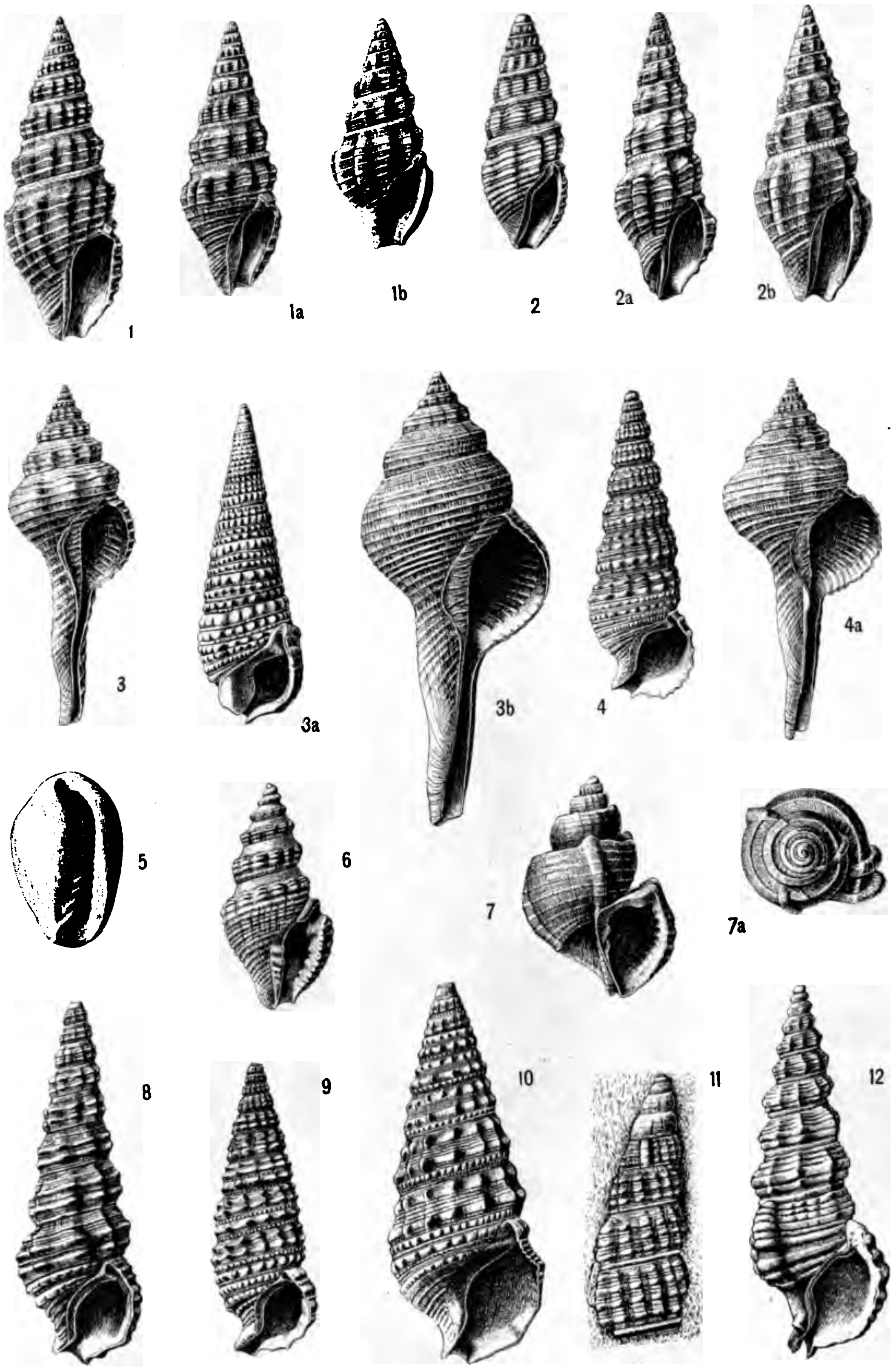
Fig. 8. *Cerithium callisoma* Dall; 24.0 mm.; p. 282.

Fig. 9. *Cerithium glaphyrea* var. *litharium* Dall; 19.0 mm.; p. 284.

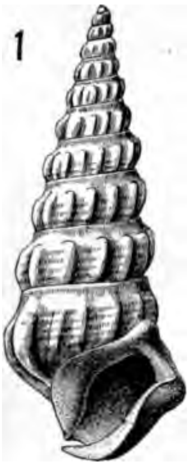
Fig. 10. *Cerithium floridanum* Mörch, not quite adult; 30.0 mm.; p. 282.

Fig. 11. *Cerithium platynema* Dall, from a gutta-percha squeeze taken from the natural mold in limestone; 26.0 mm.; p. 281.

Fig. 12. *Cerithium Burnsii* Dall; 55.0 mm.; p. 280.



TERTIARY MOLLUSKS OF FLORIDA.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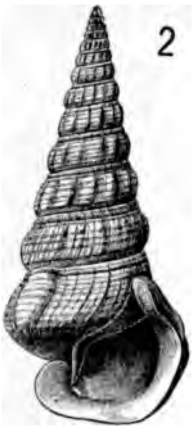
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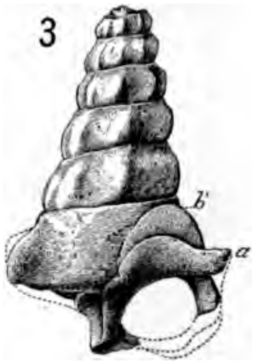
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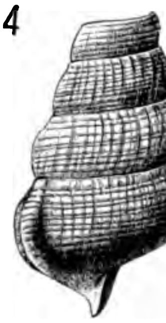
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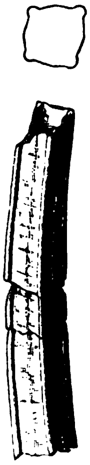
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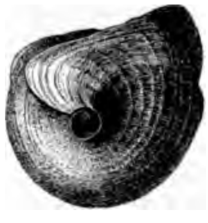
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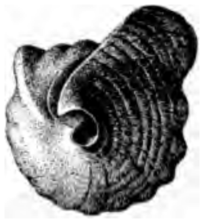
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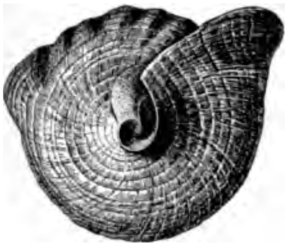
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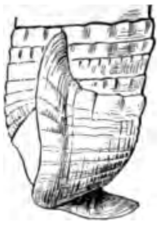
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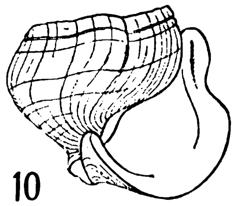
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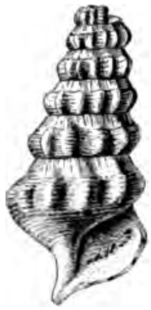
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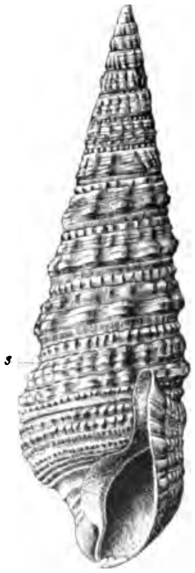
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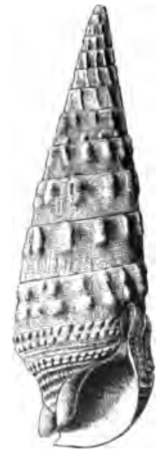
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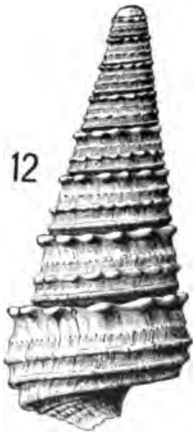
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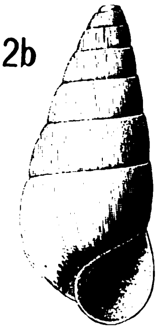
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PLATE XV.

Fig. 1. *Potamides* (*Pyrazisinus*) *scalatus* Hp.; 44.0 mm.; p. 289.

Fig. 2. *Potamides* (*Pyrazisinus*) *campanulatus* (Hp.) Dall, adult; 41.0 mm.; p. 288.

Fig. 3. *Potamides* (*Pyrazisinus*) *cornutus* (Hp.) Dall, type-specimen; *b*, normal lip; *a*, abnormal lip, formed after fracture; 49.0 mm.; p. 288.

Fig. 4. *Potamides* (*Pyrazisinus*) *scalatus* var. *ecarinatus* Dall, young; 31.0 mm.; p. 289.

Fig. 5. *Dentalium prisma* Dall, and section; 16.75 mm.; p. 442.

Fig. 6. *Potamides* (*Pyrazisinus*) *campanulatus*, base, showing completed lip; 19.5 mm.

Fig. 7. *Potamides* (*Pyrazisinus*) *scalatus*, base, showing incomplete lip; 26.0 mm.; p. 289.

Fig. 8. The same, with lip still less mature.

Fig. 9. *Cerithium caloosaënse* Dall, side view of aperture; p. 279.

Fig. 10. *Potamides* (*Pyrazisinus*) *campanulatus*, last whorl, showing the sinus in the outer lip.

Fig. 10 b. *Potamides* (*Pyrazisinus*) *scalatus*, young, with strong ribs; 38.0 mm.; p. 289.

Fig. 11. *Cerithium caloosaënse* Dall; 75.0 mm.; *s* = suture; p. 279.

Fig. 11 b. *Cerithium caloosaënse* var. *Heilprini* Dall; 40.0 mm.; p. 279.

Fig. 12. *Cerithium hillsboroënsis* Hp., from gutta-percha cast of the rock-mold, type-specimen; 31.0 mm.; p. 286.

Fig. 12 b. *Syrnola caloosaënsis* Dall; 3.4 mm.; p. 252.

PLATE XVI.

Fig. 1. *Turritella subannulata* Heilprin, var. *perincisa* Dall; 18.5 mm.; p. 314.

Fig. 2. *Turritella subannulata* Heilprin, type-specimen ; 29 mm.; p. 314.

Fig. 3. *Turritella subannulata* Heilprin, var. *intermedia* Dall ; 14 mm.; p. 315.

Fig. 4. *Turritella subannulata*, var. *acropora* Dall; 18 mm.; p. 315.

Fig. 5. *Turritella perattenuata* Heilprin, var.; 100 mm.; view of another specimen, with a diagram of the lines of growth ; p. 316.

Fig. 6. *Meioceras cingulatum* Dall, in profile; 2.25 mm.; p. 302.

Fig. 7. Same specimen from below; 2.25 mm.; p. 302.

Fig. 8. *Bittium* (*Styliferina*) *cerithidioides* Dall; 3.5 mm.; p. 276.

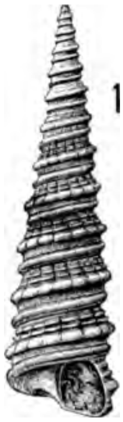
Fig. 9. *Turritella perattenuata* Heilprin ; 120 mm.; p. 316.

Fig. 10. *Turritella apicalis* Heilprin; type-specimen; 42 mm.; pp. 316, 317.

Fig. 11. *Turritella apicalis*, var. *cingulata* Heilprin ; type-specimen; 55 mm.; p. 317.

Fig. 12. *Turritella apicalis*, var. *mediosulcata* Heilprin, type-specimen ; 37 mm.; p. 317.

Fig. 13. *Turritella apicalis*, var. *tensa* Dall; 67 mm. ; p. 317.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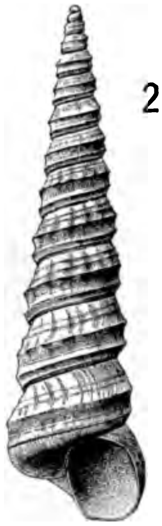
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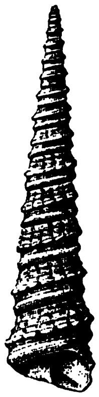
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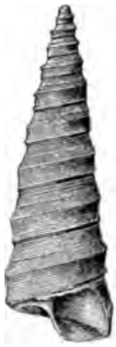
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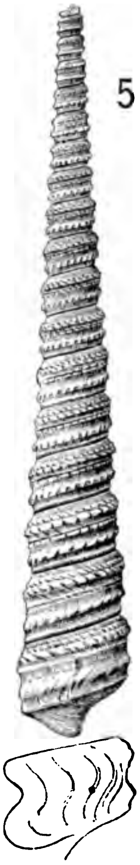
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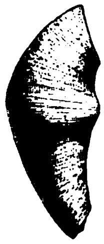
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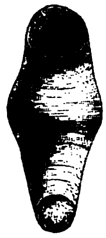
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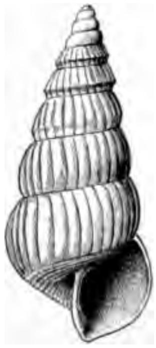
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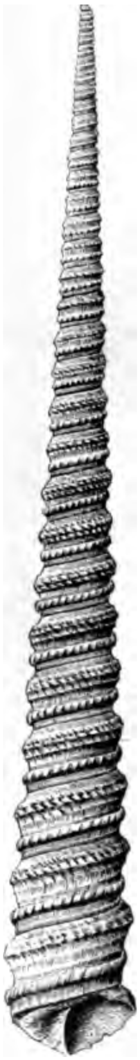
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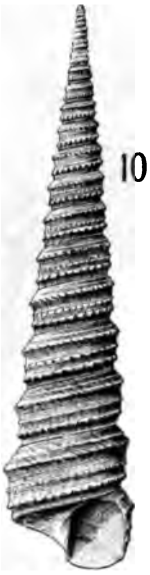
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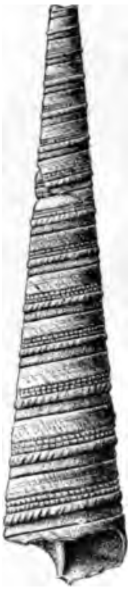
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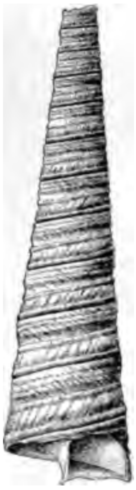
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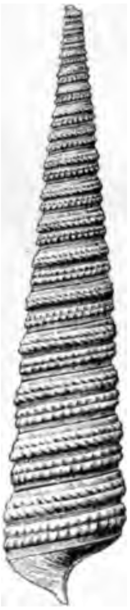
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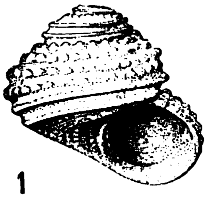

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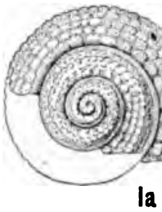

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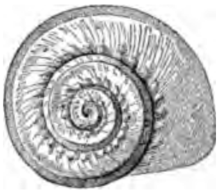

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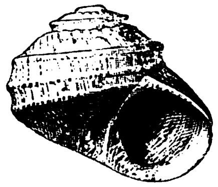

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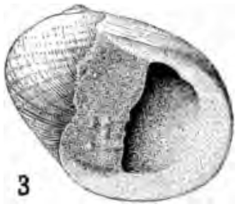

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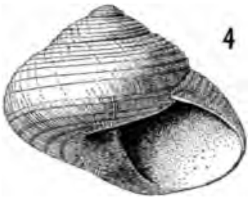

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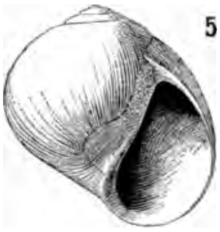

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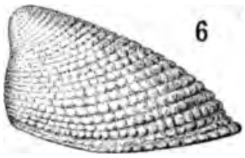

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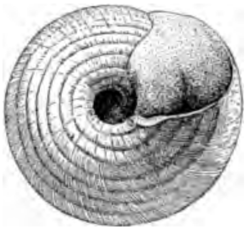

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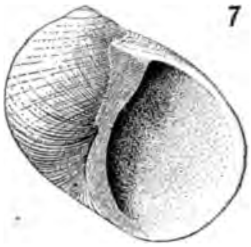

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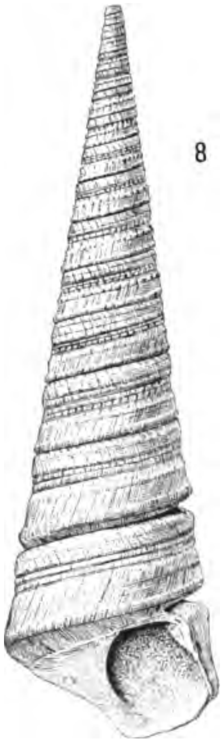

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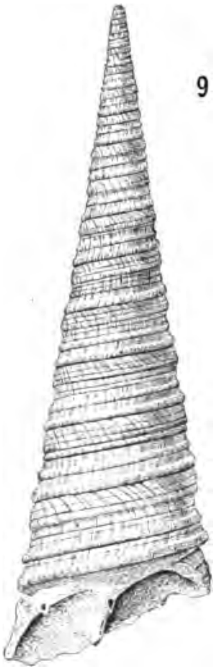

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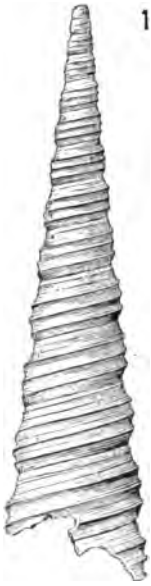

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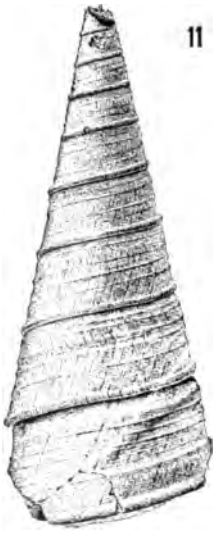

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PLATE XVII.

Species from the Orthaulax bed, Ballast Point, Tampa Bay, Florida.

Fig. 1. *Liotia solariella* Heilprin, sp.; diam. 5.8 mm.; p. 408.

Fig. 1 a. *Liotia solariella* Heilprin, sp., from above; 5 8 mm.; p. 408.

Fig. 2. *Liotia coronata* Dall, from above; diam. 5.0 mm.; p. 409.

Fig. 2 a. *Liotia coronata* Dall; profile; alt. 4.0 mm.; p. 409.

Fig. 3. *Nerita tampaënsis* Dall; alt. 10.0 mm.; p. 421.

Fig. 4. *Omphalius exoletum* Conrad; the specimen is slightly defective on the pillar, not showing the tubercles; 12.0 mm.; p. 388.

Fig. 4 a. *Omphalius exoletum* Conrad; base of the same specimen; p. 388.

Fig. 5. *Natica (Cryptonatica) floridana* Dall; alt. 7.5 mm.; p. 366.

Fig. 6. *Amalthea Willcoxii* Dall; lon. of base 9.0 mm; p. 359.

Fig. 7. *Sigaretus chipolanus* Dall; alt. 11.5 mm.; p. 379.

Fig. 8. *Turritella tampæ* Heilprin; 75 mm.; p. 309.

Fig 9. *Turritella pagodæformis* Heilprin; 50.0 mm.; p. 310.

Fig. 10. *Turritella galunensis* Conrad; 28 0 mm.; p. 310.

Fig. 11. *Turritella megalobasis* Dall; 64.0 mm.; p. 310.

PLATE XVIII.

Fig. 1. *Calliostoma Willcoxianum* Dall ; type-specimen ; diam. 16 mm. ; p. 395.

Fig. 1 a. *Modulus Willcoxii* Dall ; alt. 20 mm. ; p. 294.

Fig. 2. *Calliostoma virginicum* Conr.; alt. 13 mm. ; p. 396.

Fig. 2 a. *Calliostoma grammaticum* Dall ; alt. 13.5 mm. ; p. 397.

Fig. 3. *Dillwynella naticoides* Lea, sp.; diam. 7 mm.; p. 418.

Fig. 3 a. *Fossarus lyra* Conrad, sp.; alt. 4 mm.; p. 322.

Fig. 4. *Liotia milium* Dall ; diam. 1.8 mm.; p. 409.

Fig. 4 a. *Tuba acutissima* Dall; alt. 7.5 mm.; p 319.

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Fig. 7 a. *Calliostoma* (*Eutrochus*) *limulum* Dall ; alt. 6 mm.; p. 404.

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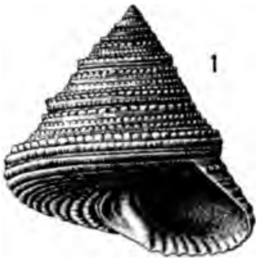
Fig. 10. *Calliostoma* (*Eutrochus*) *ceramicum* Dall ; alt. 15 mm.; p. 404.

Fig. 11. *Turbo rhectogrammicus* Dall ; alt. 46 mm. ; p. 383.

Fig. 12. *Modulus turbinatus* Heilprin, sp.; alt. 21 mm.; p. 294.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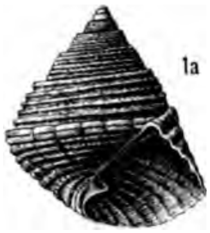
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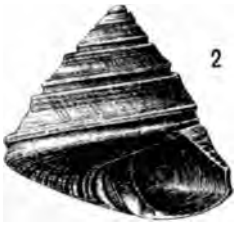
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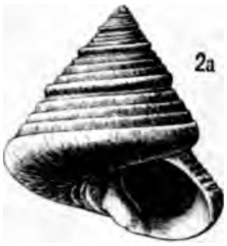
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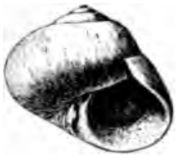
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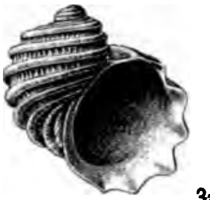
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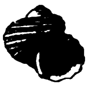
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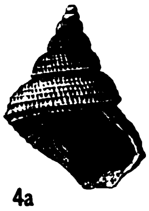
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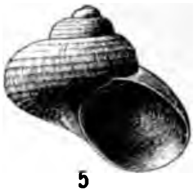
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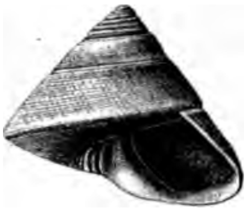
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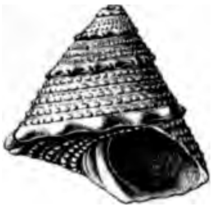
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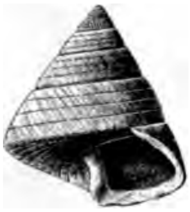
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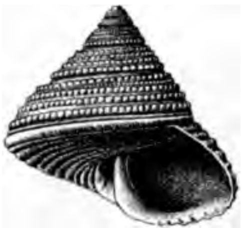
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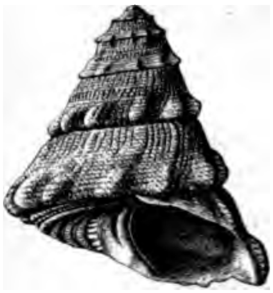
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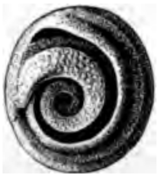
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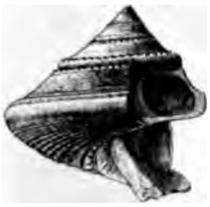
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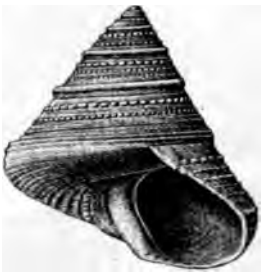
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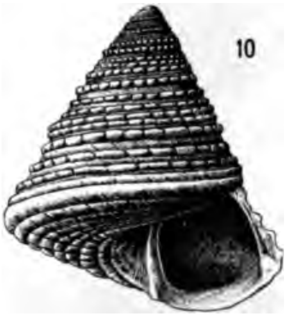
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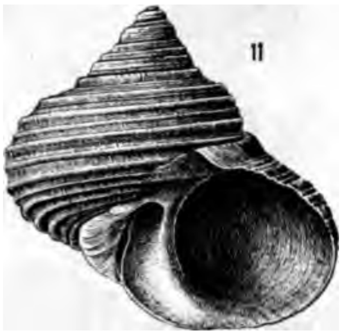
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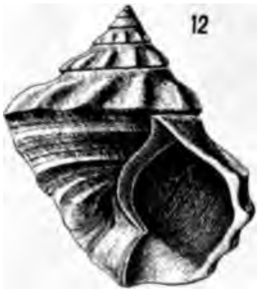
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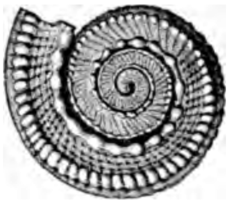
TERTIARY MOLLUSKS OF FLORIDA.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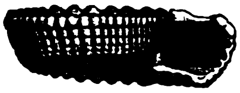
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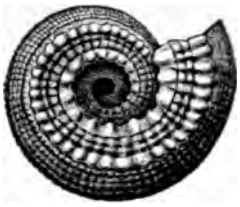
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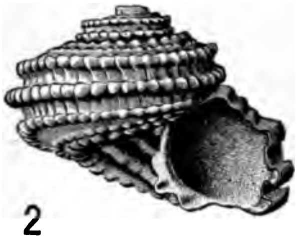
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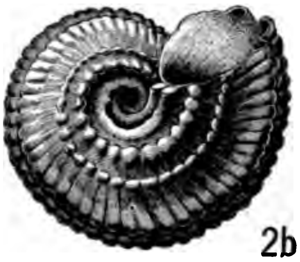
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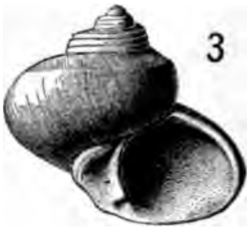
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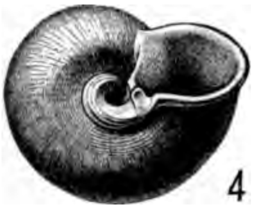
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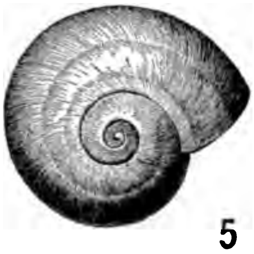
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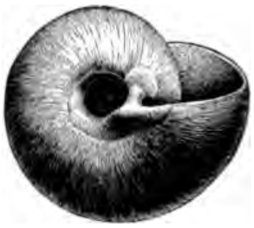
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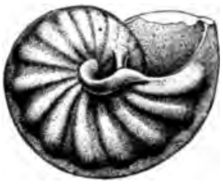
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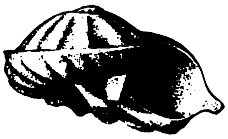
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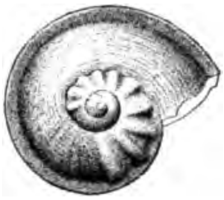
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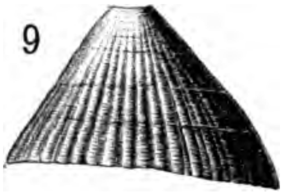
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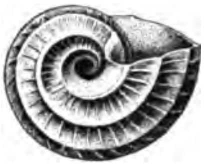
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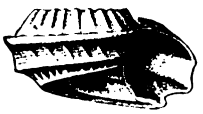
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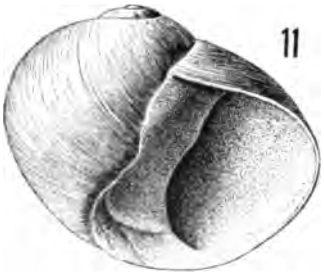
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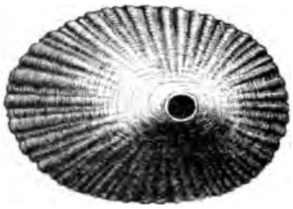
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TERTIARY MOLLUSKS OF FLORIDA.

PLATE XIX.

Fig. 1. *Discohelix retifera* Dall, summit; diam. 4.5 mm.; p. 332.

Fig. 1 b. The same shell, in profile; p. 332.

Fig. 1 c. The same shell, view of the base; p. 332.

Fig. 2. *Liotia perarmata* Dall, not quite adult; diam. 5.0 mm.; p. 409.

Fig. 2 b. The same shell, from below; diam. 5.0 mm.; p. 409.

Fig. 3. *Collonia elegantula* Dall; 4.25 mm.; p. 386.

Fig. 4. The same, from below; 4.5 mm.; p. 386.

Fig. 5 *Teinostoma opsitelotus* Dall, immature specimen, from above; 3.3 mm ; p. 414.

Fig. 5 b. The same, from below; in the adult the umbilicus is covered with callus; p. 414.

Fig. 6. *Collonia radiata* Dall, base; 2 mm.; p. 387.

Fig. 7. The same, from in front; 2.0 mm.; the outer lip is broken; p. 387.

Fig. 8. The same, view of upper surface; 2.0 mm.; p. 387.

Fig. 9. *Fissuridea nucula* Dall, in profile; 4.75 mm.; p. 426.

Fig. 10. *Adeorbis strigillatus* Dall, basal view; 2.0 mm.; p. 345.

Fig. 10 b. The same, in profile; 2.0 mm.; p. 345.

Fig. 11. *Neritina edentula* Dall; 6.0 mm.; p. 422.

Fig. 12. *Fissuridea nucula* Dall, from above; 4.75 mm.; p. 426.

PLATE XX.

Fig. 1. *Rissoina Johnsoni* Dall; 5.25 mm.; p. 342.

Fig. 2. *Utriculus vaginatus* Dall, type; 3.25 mm; p. 219.

Fig. 3. *Bittium annettæ* Dall; 5.75 mm.; p. 273.

Fig. 4. *Niso lineata* (Conr.) Dall; 11.5 mm.; p. 245.

Fig. 5. *Ondina fragilis* Dall; 4.75 mm.; p. 253.

Fig. 6. *Phalium globosum* Dall, from a gutta-percha cast taken from a mold in the Ocala nummulitic limestone; lat. 19.25 mm.; p. 262.

Fig. 7. *Polynices* (*Lunatia*) *internus* Say; 18.75 mm.; p. 372.

Fig. 8. *Fusus quinquespinus* Dall; 32.25 mm.; p. 234.

Fig. 8 a. *Onoba microcharia* Dall; 1.12 mm.; p. 341.

Fig. 8 b. *Rissoa lipeus* Dall; 1.3 mm.; p. 339.

Fig. 9. *Caricella podagrina* Dall, type; 90 mm.; p. 228.

Fig. 9 b. *Cæcum floridanum* Stm. var. *compactum* Dall; 3.6 mm.; p. 298.

Fig. 10. *Rimula caroliniana* Dall; 5.0 mm.; p. 429.

Fig. 10 a. *Cæcum ibex* Dall; 5.0 mm.; p. 301.

Fig. 11. *Phalium globosum* Dall, young shell from the Chipola beds; 13.75 mm.; p. 262.

Fig. 11 a. *Cæcum coronellum* Dall; 6.0 mm.; p. 298.

Fig. 12. *Sigaretus multiplicatus* Dall, from above; lat. 43.75 mm.; p. 379.

Fig. 12 b. *Sigaretus multiplicatus* Dall, type-specimen in profile; p. 379.

Fig. 13. *Scala* (*Opalia*) *De-Bouryi* Dall; 24.5 mm.; p. 244.

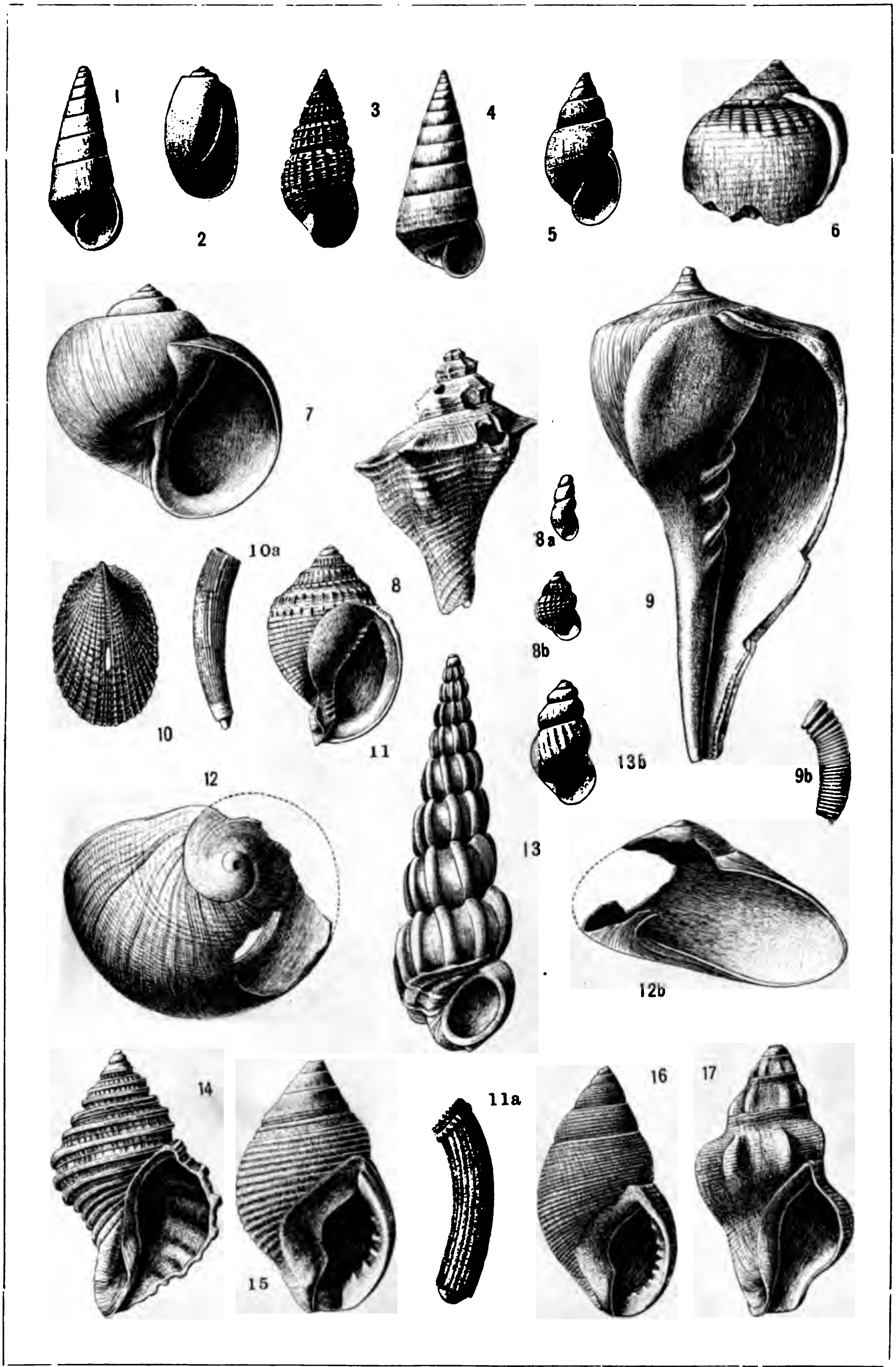
Fig. 13 b. *Rissoa athymorhyssa* Dall; 2.5 mm.; p. 340.

Fig. 14. *Rapana tampaënsis* Dall, var. ?; 34.0 mm.; p. 244.

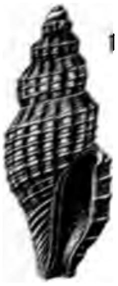
Fig. 15. *Ilyanassa arata* Say; 20.5 mm.; p. 238.

Fig. 16. *Ilyanassa isogramma* Dall; 24.0 mm.; p. 239.

Fig. 17. *Solenosteira inornata* Dall, a restoration from gutta-percha casts taken from several molds; 38.0 mm.; p. 234.



TERTIARY MOLLUSKS OF FLORIDA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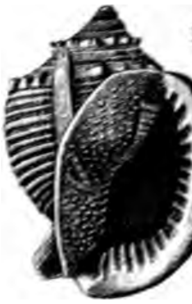
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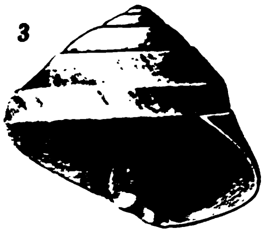
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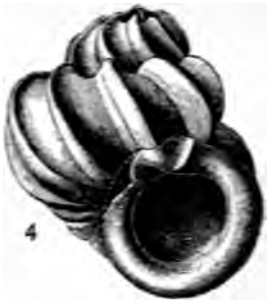
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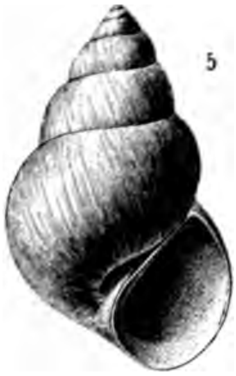
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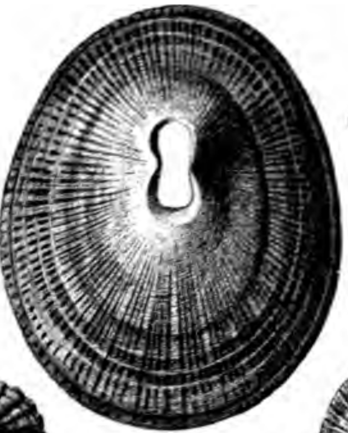
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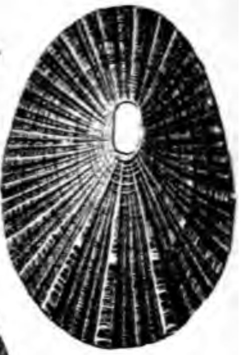
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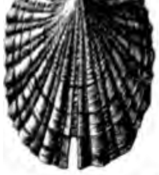
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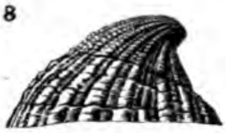
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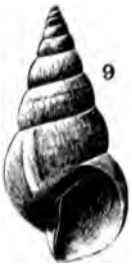
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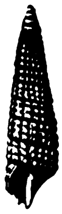
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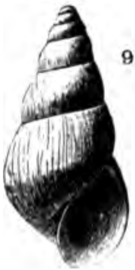
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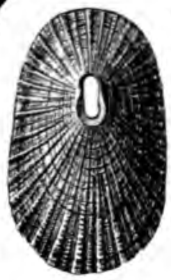
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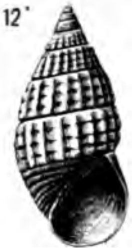
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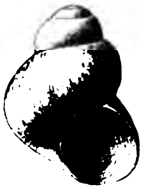
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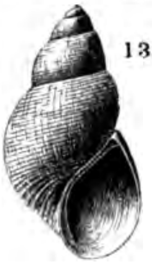
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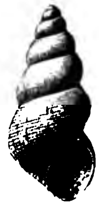
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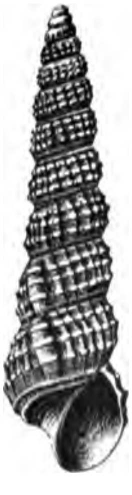
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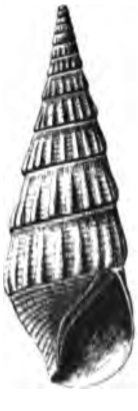
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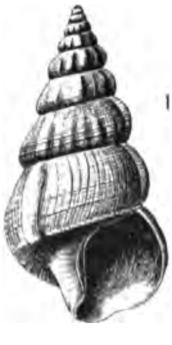
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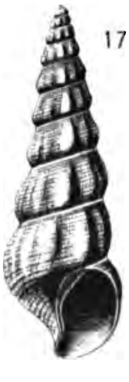
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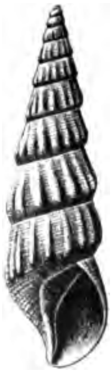
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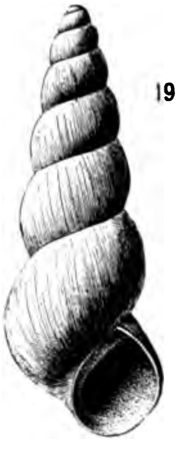
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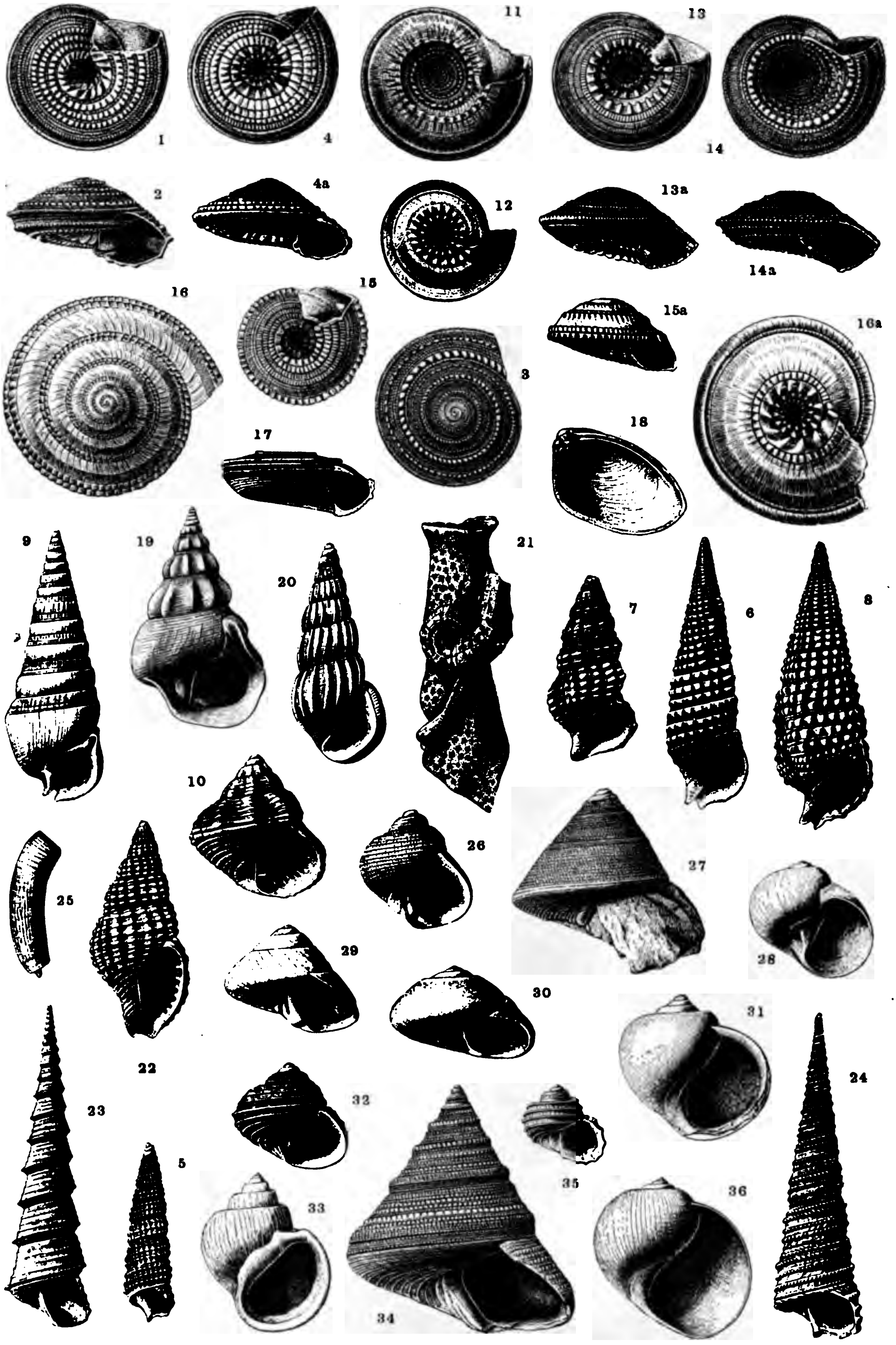

TERTIARY MOLLUSKS OF FLORIDA

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